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The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

The Institution of Naval Architects.

Utilisation of Exhaust Steam in Locomotives (No. II).

New Muskham Bridge on the Great North Road.

The Salving of a Capsized Steamship (With a Two-Page Supplement).

Bombay Water Supply—No. II.

Steam Nozzles Research.

Some New Arc Welding Machines.

Stone Drying and Tarring Plant.

PUBLIC NOTICES

Chief Draughtsman Re-QUIRED by the Government of Nigeria for the Engineering Department of the Railway for two tours, each of not less than 12 nor more than 18 months, with possible extension. Salary £480-£30-£720-£40-£800 a year. Outfit allowance of £60 on first appointment. Free quarters and passages. Liberal leave in England on full salary. Candidates, age 25 to 35, must have had good experience in the design of buildings, preparation of estimates and taking out quantities, and preferably have a knowledge of railway construction and maintenance work generally.

Apply at once by letter, stating age and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/11,880. 1923

Cape Technical College, Cape TOWN.

APPLICATIONS are invited for the following POST:—

LECTURER in MECHANICAL ENGINEERING, salary £400-25-600.

Applications, which will be received up to the 31st March, 1923, must be accompanied by certified copies of testimonials of training and teaching experience and should state age of applicant. Holders of such posts may be required to join the Government Provident Scheme. Two years' probation, subject to six months' notice on either side; afterwards, three months' notice. £50 allowed for travelling expenses, but a proportionate amount of this to be repaid if the contract is terminated in less than two years. Long leave after six years, three months on full, three months on half salary.—Applications to be sent to Messrs. CHALMERS, GUTHRIE and CO., Ltd., 9, Idol-lane, London, E.C. 3. 1831

NOW READY.

Full Report of the General DISCUSSION on THE GENERATION & UTILISATION OF COLD, held by The Faraday Society and the British Cold Storage and Ice Association, October, 1922.

Price 10s. 6d. net, including postage. 137 pp., in limp cloth covers.—Orders should be sent to the FARADAY SOCIETY, 10, Essex-street, London, W.C. 2. 1869

Administrative County of LONDON.

The London County Council invites TENDERS for THREE NEW "LANCASHIRE" BOILERS, with fittings, for Abbey Mills Pumping Station, Abbey-lane, Stratford, London, E. 15, each boiler to be 30ft. long by 8ft. diameter.

Persons desiring to tender may obtain on and after Monday, 26th March, 1923, the drawings, specification, form of Tender, &c., on application to the Chief Engineer at the Old County Hall, Spring-gardens, S.W. 1, upon payment of the sum of £2. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender, and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the drawings, specification and other contract documents may be inspected, at the Old County Hall before payment of the fee.

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 23rd April, 1923, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

JAMES BIRD,
1943 Clerk of the London County Council.

Administrative County of LONDON.

The London County Council invites QUOTATIONS for the PURCHASE and REMOVAL of FIVE LANCASHIRE BOILERS, each 22ft. long by 8ft. diameter, together with Fittings, Pipes, &c.

The boilers, &c., may be inspected at the Council's Northern Outfall Works, by Beckton Gasworks, East Ham, E. 6.

Forms for Quotation, conditions of sale and full particulars may be obtained on application to the Chief Engineer, at the Old County Hall, Spring-gardens, S.W. 1.

Quotations must be addressed to the Clerk of the Council, and must be delivered at the County Hall, Westminster Bridge, S.E. 1, not later than 4 p.m., on Monday, 9th April, 1923. No Quotation received after this time will be considered.

The Council does not bind itself to accept any Quotation.

JAMES BIRD,
1954 Clerk of the London County Council.

Bethnal Green Hospital.

INSTALLATION OF CENTRAL HEATING PLANT.

The Bethnal Green Board of Guardians invite TENDERS for the INSTALLATION of CENTRAL HEATING PLANT and MAINS to be connected to existing radiators at their Hospital, Cambridge-road, Bethnal Green, N.E. 2.

Form of Tender, with specification and plan, will be supplied upon application being made to me, accompanied by a deposit of £2, which will be returned upon receipt of a bona fide Tender. Sealed Tenders, endorsed "Central Heating Plant," to be delivered at my office as undermentioned not later than Twelve (Noon) on the 17th day of April, 1923. The Guardians do not bind themselves to accept the lowest or any Tender.

C. FAULKNER JONES,
Clerk to the Guardians.

Administrative Offices,
79A, Bishop's-road, E. 2.
20th March, 1923. 1943

The Great Indian Peninsula RAILWAY COMPANY.

The Directors are prepared to receive TENDERS for the SUPPLY of the following STORES, namely—

Fee for specification.

4-WHEELED OPEN GOODS WAGONS .. £1

Specifications and forms of Tender may be obtained at this office on payment of the fee for the specification, which payment will not be returned.

The fee should accompany any application by post Cheques and postal orders should be crossed and made payable to the Great Indian Peninsula Railway Company.

Tenders must be delivered in separate envelopes, sealed and addressed to the undersigned, marked "Tender for 4-Wheeled Open Goods Wagons," not later than Eleven o'clock a.m. on Tuesday, the 10th April, 1923.

The Directors do not bind themselves to accept the lowest or any Tender.

R. H. WALPOLE,
Secretary.

Company's Offices,
48, Osphall-avenue, E.C. 2.
London, 21st March, 1923. 1949

PUBLIC NOTICES

TO ENGINEERS AND SHIPBUILDERS.

The Conservators of the River Thames invite TENDERS for the CONSTRUCTION and DELIVERY afloat in the Thames at Teddington Lock, Middlesex, of a STEEL SINGLE-SCREW (or alternatively twin-screw) STEAM RIVER TUG of the following overall dimensions, for use on the upper Thames above Teddington:—

Extreme dimensions, 58ft. by 13ft. 6in. by 6ft. 3in.
Draught, limited to 4ft. 6in. aft and 4ft. forward in working trim.
Frames, 21in. by 21in. by 5-16in., spaced 14in./18in. apart, with reverse frames, 3in. by 2in. by 4in., plating 3-8in. and 5-16in., plate keel doubled.
Bulwarks of 4in. plate, 18in. high, to tumble in.
Decks, 5-16in. chequered plate.
Keelson and side keelsons of ample strength.
Engines, Compound (or triple-expansion) surface condensing, to develop at work at least 150 I.H.P.
Boiler, marine, 8ft. by 8ft., 150 w.p., to pass Board of Trade special survey.
Trimming tanks, fore and aft, and pump for filling and emptying.
Propeller, cast steel, 4ft. 6in. diameter if single screw.
All top hamper to pass under headway of 8ft. 6in. above water line, funnel to be made to lower.
The whole to be of first-class British workmanship and British materials, complete with one cabin, store-house and usual equipment, and at least equal in all respects to Board of Trade and Lloyd's regulations.
Earliest date when delivery can be effected should be stated.
All inquiries should be addressed to the Chief Engineer at the undermentioned address.
Sealed Tenders, marked "Tender for Tug," accompanied by drawings and full specifications and addressed to the Conservators of the River Thames, 2/3, Norfolk-street, Strand, London, W.C. 2, must be delivered not later than 10 a.m. on Monday, 23rd April, 1923. No Tender after that time will be considered.
The Conservators do not bind themselves to accept the lowest or any Tender.

F. W. GEARY,
Secretary.

Thames Conservancy Offices,
2/3, Norfolk-street,
Strand, London, W.C. 2,
20th March, 1923. 1911

The Madras and Southern MAHRATTA RAILWAY COMPANY, LTD.

The Directors are prepared to receive TENDERS for
(i) 12 PETROL TANK WAGONS (FOUR-WHEELED), I.R.C.A. STANDARD TYPE K 1 (without Wheels and Axles) (BROAD GAUGE);
(ii) 5 BOGIE OIL TANK WAGONS (35ft. long), I.R.C.A. STANDARD TYPE M.B.J. 1;
22 TIMBER TRUCKS (FOUR-WHEELED) (19ft. long);
100 COVERED GOODS WAGONS (FOUR-WHEELED) (18ft. long), I.R.C.A. STANDARD TYPE M.A. 1 (without Wheels and Axles), all of (ii) METRE GAUGE;
(iii) 288 Pairs WHEELS and AXLES, 24 Prs. BROAD GAUGE and 264 Prs. METRE GAUGE, for the various Wagons and Trucks detailed in (i) and (ii) above;
(iv) 50,000 DOG SPIKES;
50,000 CHAIR SPIKES;

in accordance with the specifications which may be seen at the offices of the Company. The charge for each specification is One Guinea, with the exception of No. (iv), the charge for which is Half-Guinea, which will not be returned. Tenders must be sent in, addressed to the SECRETARY, not later than 2 p.m. on Tuesday, 17th April, 1923, and marked "Tender for Petrol Tank Wagons," or as the case may be.

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Offices—
25, Buckingham Palace-road,
Westminster, S.W. 1.
20th March, 1923. 1951

PUBLIC NOTICES

Corporation of Calcutta.

NOTICE TO CONTRACTORS.

The TIME for the SUBMISSION of TENDERS for the SUPPLY, ERECTION, and INSTALLATION of an AERIAL ROPEWAY for the removal of the city refuse has been EXTENDED from 30th April, 1923, to 1st JUNE, 1923. Tenders must reach the Deputy Chairman, Corporation of Calcutta, 5, Corporation-street, on or before 2 p.m. on Friday, the 1st June, 1923, instead of Monday, the 30th April, 1923, as previously advertised.

JAMES R. COATS, B.Sc., M.I.C.E.,
Chief Engineer.

Central Municipal Office,
20th February, 1923. 1816

East Indian Railway.

The Directors are prepared to receive up to Eleven o'clock a.m. on Wednesday, the 4th April, TENDERS for the SUPPLY of—

STEEL MATERIAL (Mild Steel Hoop, Plates and Sheets).

Copies of the specification can be obtained at the Company's offices on payment of £1 1s. each. This fee will not be returned.

G. E. LILLIE,
Secretary.

73-76, King William-street, London, E.C. 4.
21st March, 1923. 1952

Bombay Improvement Trust.

WANTED IMMEDIATELY, TWO EXECUTIVE ENGINEERS on Works Establishment on three years' agreements, salaries Rs. 1200 per mensem, with annual increments at the rate of Rs. 50 p.m. for approved service up to Rs. 1300, and, if the service be continued, up to a maximum of Rs. 1500 per mensem.

Candidates must not be under 30 years or over 40 years of age.

They must be corporate members of the Institution of Civil Engineers or hold an exempting degree in engineering. They must have had experience in responsible positions in charge of large works and proved capacity for organising and controlling large bodies of labour.

Preference will be given to those with experience in the construction and carrying out of large works by direct labour.

Applications, with copies of testimonials (which will not be returned), should be addressed to Messrs. RENDEL, PALMER and TRITTON, 12/14, Dartmouth-street, Westminster, S.W. 1, on or before 10th April, 1923. 1906

Chesham Urban District Council.

The Chesham Urban District Council invite APPLICATIONS from qualified engineers with special experience in drainage for the POST of ENGINEER in connection with the work of thoroughly Overhauling, Examining, and Re-laying or Repairing and generally Improving the Sewerage System and House Connections in the Urban District. The work will be done by day labour and the person appointed will be responsible for the engaging and control of labour, the keeping of the necessary labour sheets, books and accounts, and will be required to attend the Auditor in connection therewith. An office and all office requisites will be provided.

The person appointed will be required to reside within the Urban District and to devote his whole time and attention to the duties and be directly responsible to the Council for the performance thereof.

The salary will be at the rate of £600 per annum and the appointment will be determinable by one month's notice from either side.

Applications, stating age and qualifications, with particulars of experience in the kind of work to be undertaken by the Council, and to be accompanied by copies of not more than three recent testimonials, to be sent to me not later than first post on Friday, the 30th March, 1923. Applications to be endorsed "Engineer."

W. J. STANDRING,
Clerk of the Council.

Chesham, Bucks.,
March, 1923. 1908

PUBLIC NOTICES

Shanghai Municipal Council.

PUBLIC WORKS DEPARTMENT.

ASSISTANT ENGINEER.

A fully qualified ASSISTANT ENGINEER is REQUIRED in the Public Works Department of the Shanghai Municipal Council. Candidates must be between 28 and 32 years of age and unmarried. They should hold the testamur of the Institution of Municipal and County Engineers or have passed the examination for the associate membership of the Institution of Civil Engineers, or hold a degree in engineering from a university in Great Britain. They should also have had at least two years' experience on constructional works.

Salary Taels 400 per mensem, under a three years' agreement, which is renewable at a higher salary in the event of satisfactory services. First-class passage is granted, with half-pay during voyage. Free medical attendance is provided, and the employee participates in the benefits of a superannuation fund. A tael at the present rate of exchange equals 3s. 1d.; exchange is, however, subject to fluctuation. Taels 400 per mensem at exchange 3s. 1d. is equivalent to about £740 per annum.

Particulars of the appointment and also full details as to the benefits enjoyed by municipal employees under their terms of service may be obtained from the Council's Agents, and applications, in candidates' own handwriting, with full information as to experience, &c., accompanied by copies of at least three recent testimonials and endorsed "Assistant Engineer" on the cover, should be forwarded at the earliest possible moment to

Messrs. JOHN POOK and CO.,
Agents for the Municipal Council of Shanghai,
63, Fenchurch-street,
London, E.C. 3,
March, 1923. 1780

Shanghai Municipal Council.

PUBLIC WORKS DEPARTMENT.

CLERK OF WORKS.

FOUR fully qualified CLERKS of WORKS are REQUIRED in the Public Works Department of the Shanghai Municipal Council. Candidates must be about 30 years of age and unmarried. Preference will be given to applicants thoroughly experienced in sewer construction and general engineering work. Salary Taels 235 per mensem, under a three years' agreement, which is renewable at a higher salary in the event of satisfactory services. Second-class passage is granted, with half-pay during voyage. Free medical attendance is provided, and the employee participates in the benefits of a superannuation fund. A tael at the present rate of exchange equals 3s. 1d.; exchange is, however, subject to fluctuation. Taels 235 per mensem at exchange 3s. 1d. is equivalent to about £527 per annum.

Particulars of the appointments and also full details as to the benefits enjoyed by municipal employees under their terms of service may be obtained from the Council's Agents, and applications, in candidates' own handwriting, with full information as to experience, &c., accompanied by copies of at least three recent testimonials and endorsed "Clerk of Works" on the cover, should be forwarded at the earliest possible moment to

Messrs. JOHN POOK and CO.,
Agents for the Municipal Council of Shanghai,
63, Fenchurch-street, E.C. 3. 1749

20th March, 1923.

The Sudan Government Rail-WAYS REQUIRE the SERVICES of:—

DISTRICT TRAFFIC MANAGER, of good education, with experience in Traffic Department, British Railway. Age 23 to 30. Single. Commencing salary £E480 per annum.

DISTRICT LOCOMOTIVE SUPERINTENDENT, of good education, trained in locomotive works or on British railway, having A.M.I.C.E. degree or equivalent. Commencing salary £E480 per annum.

Progressive posts if retained after first contract.—Apply by letter, giving particulars of education, training, age, &c., to CONSULTING MECHANICAL ENGINEER, Sudan Government Railways and Steamers, 5, Northumberland-avenue, W.C. 2. 1913

SITUATIONS OPEN

WILL All Applicants to Box 1707, for Position of DRAUGHTSMAN, please note that the VACANCY has now been FILLED. 1897 A

WANTED by General Engineering Firm, Birmingham district, young CIVIL ENGINEERING DRAUGHTSMAN who has experience of Lay-outs for Crushing, Screening, and Mixing Plants, Inquiries, and the like. Must be competent to survey at site and set out work both on the drawing board and on the ground.—Address, 1885, The Engineer Office. 1885 A

WANTED.—Experienced CHEMICAL WORKS ENGINEER REQUIRED for a large Chemical Factory in the Midlands; thoroughly acquainted with the design, construction, and operation of all classes of Chemical Plant.—Address particulars of scientific training, with details of experience, copies of testimonials, salary required, 1926, The Engineer Office. 1926 A

SITUATIONS OPEN (continued) Page 2.

SITUATIONS WANTED, Page 2.

PARTNERSHIPS, Page 2.

PATENTS, Page 2.

MACHINERY, &c., WANTED, Page 3.

FOR SALE, Pages 3 and 4.

AUCTIONS, Pages 3 and 96.

PREMISES TO LET OR WANTED Page 3.

WORK WANTED, Page 4.

AGENCIES, Page 2.

MISCELLANEOUS, Page 2.

For Advertisement Rates See Page 317, Col. 1.

NUMERICAL INDEX TO ADVERTISEMENTS, Page 95.

SITUATIONS OPEN (continued)

WANTED, ENGINEER, Expert in Up-to-date Wireless, including Telephony and Direction Finding; well-educated, possessing thorough training and extensive experience as Mechanical and Electrical Engineer and in Internal Combustion Engines and Compressing Plants; Draughtsman, used to Design of Mechanical and Structural Details; age 20-31. Permanent pensionable appointment. Base rate for 2/3 years £350, equals £504 with present Civil Service bonus, rising to base £500, equals £696 with bonus. Bonus varies with cost of living. Civil engineering experience not required, and amateur wireless no qualification.—Address, 1945, The Engineer Office. 1945 A

WANTED for Confidential Position in Midlands, well-educated MAN, about 30 years of age, experienced in Estimating and Making-up Prices for Bridge and Constructional Work; Drawing-office Training essential.—Address, stating experience, salary, P7147, The Engineer Office. P7147 A

WANTED.—Several ENGINEERING GRADUATES, preferably with an engineering degree, REQUIRED for Training as Sectional Engineers in a large Chemical Factory in the Midlands. Good prospects for men with scientific knowledge, initiative, and energy.—Address, 1927, The Engineer Office. 1927 A

WANTED, JUNIOR ASSISTANT ENGINEER, preferably one just terminated his articles and passed the A.M.I.C.E., or other approved examinations. The salary offered will be small, but the experience which will be gained will be useful. The post will be with a contractor undertaking civil engineering work. Write fully in first instance. 1913, The Engineer Office. 1913 A

A LARGE MANUFACTURING FIRM in England REQUIRES the ASSISTANCE of an ENGINEER with general experience in the design, construction, and the practical operation in service of Electric Locomotives.—Address, stating experience and salary required, 1916, The Engineer Office. 1916 A

AMBITIOUS FOUNDRYMEN, Iron and Brass, also ENGINEERS and DRAUGHTSMEN who are desirous of securing better positions should obtain "The Foundryman's Educator," giving mixtures of non-ferrous metals and alloys, irons and foundry productions. If it is your ambition to become foundry manager or a works manager or foreman, this book will guide you to secure one of these positions in life which you may be worthy of. Don't stand in your own way; write at once, as they are being rapidly taken up. Post free 6s. to any part of the world.

"FOUNDRYMAN'S EDUCATOR" Offices, Harefield Hall, Heywood, Lancs. P7001 A

APPLICATIONS are WANTED for the POSITION of GENERAL MANAGER of Associated British Machine Tool Makers, Ltd.—Apply by letter, giving full particulars of qualifications, salary required, &c. to the CHAIRMAN, 17, Grosvenor-gardens, London, S.W. 1. 1864 A

COMPETENT ENGINEER WANTED by Old-established firm to introduce Refrigerator Work. Must take full responsibility for designing, &c. Adequate assistance provided.—Address, stating age, experience, and salary required, 1881, The Engineer Office. 1881 A

ENGINEERING COMPANY REQUIRES Efficient CORRESPONDENT, capable of conducting extensive selling campaign for engineering specialities; knowledge of German advantageous. State age, complete record of previous experience and salary expected.—Write, "O. R.," c/o Street's, 30, Cornhill, E.C. 3. 1890 A

ENGINEER.—WANTED, Trained ENGINEER, with experience of mass production (in Motor Works preferred), to organise production on Ford lines and to take full control of both management and output in large works in London district.

Apply by letter only, stating age, experience, references, and salary required, to SHUTTLEWORTH and HAWORTH, Chartered Accountants, Lloyd's Bank Buildings, King-street, Manchester. 1899 A

MANAGER REQUIRED for Engineering Works making standardised Gasworks Plant and Equipment. Must be good organiser and disciplinarian, not over 40. State age, salary required, where previous experience gained, and when ready to commence. Acquaintance with mass production methods an advantage.—Address, 1901, The Engineer Office. 1901 A

SALES ENGINEER for Contractor's Plant WANTED for India. Must have first-class education, combined with selling ability and preferably able to prepare, unassisted, Lay-outs of Concrete Mixing and Distributing Plant, also supervise erection and running. Salary £400/£600 plus travelling expenses plus bonus on profits with reasonable increase of salary yearly. Period 3 or 5 years. Must be of good social standing and able to negotiate big business. Age 25 to 30, unmarried. State full particulars of education and experience. Will be required to undergo training at our works before proceeding overseas about August.—Address, 1903, The Engineer Office. 1903 A

WANTED AT ONCE, DRAUGHTSMAN, Experienced in design of Turbo-compressors and Blowers.—Apply, stating age, practical and theoretical training, salary required, and when free, REAVELL and CO., Ltd., Ranelagh Works, Ipswich. 1919 A

WANTED by an Important Firm of Electric Crane Manufacturers in their London office, SEVERAL First-class LEADING DRAUGHTSMEN. A good wage will be paid to suitable applicants.—Address, giving full particulars of experience and state age and salary required, 1914, The Engineer Office. 1914 A

WANTED, by Important Firm in the North, DRAUGHTSMAN, with experience of Structural Steel Work, Cranes, &c.; must be capable of preparing designs and estimates.—Address, P7151, The Engineer Office. P7151 A

WANTED, on North-East Coast, STRUCTURAL DRAUGHTSMAN, with experience in Preparation and Checking of Heavy Steel Work Designs and Details; knowledge of reinforced concrete design an advantage.—Address, stating age, experience, and salary required, 1905, The Engineer Office. 1905 A

ASSISTANT ENGINEER DRAUGHTSMAN REQUIRED for Railway on West Coast of South America; must be single; should be able to Design Track Details, such as Diamond Crossings, Switches, &c.; have a knowledge of Surveying; have a working knowledge of the Design of Structures and Civil Engineering Practice. Three years' contract. Free passage out and home. Free quarters provided. Salary to commence £500 per annum.—Write, with full particulars, to "A. E. D.," c.o. Charles Barker and Sons, Ltd., 31, Budge-row, Cannon-Street, London, E.C. 4. 1950 A

CHIEF DRAUGHTSMAN REQUIRED for Estimating Drawing-office of Structural Engineers. Must be able to take control of office and be fully qualified to Design and Estimate for all classes of Steel Structures on modern lines. Apply, stating age, experience, and salary required.—Address, "CHIEF," Wm. Porteous and Co., Advertising Agents, Glasgow. P7104 A

DRAUGHTSMAN REQUIRED for North-East Coast, with experience of Lay-out of Electricity Works Plant. Superficial knowledge only of electrical side required, but must have good experience of mechanical and steam practice.—Address, stating full particulars and salary, 1898, The Engineer Office. 1898 A

SITUATIONS OPEN (continued)

DRAUGHTSMEN WANTED, Accustomed to the Designing of Coal Screening and Sorting Plant.—Apply, stating age, experience, and salary required, to PLOWRIGHT BROS., Ltd., Brampton Ironworks, Chesterfield. 1915 A

DRAUGHTSMAN WANTED, Experience in Light Structural Steel and Crane Work.—State experience, with references, to "DRAFTSMAN," Clippenham Works, Slough. 1948 A

DRAUGHTSMAN WANTED for Midlands District, thoroughly conversant with Design of Steam Engines and Pumping Machinery. Progressive position for suitable man. Must have had works experience.—Address, stating age, experience, and salary required, 1861, The Engineer Office. 1861 A

DRAUGHTSMEN WANTED, with General Engineering experience. Crane work an advantage. Non-union men only. Liberal salary will be paid to suitable men. Experienced LADY TRACERS are also WANTED.—Address, stating age, experience, and salary expected, 1875, The Engineer Office. 1875 A

DRAUGHTSMAN WANTED by East Midland Firm manufacturing Pumping Machinery. State age, experience, and salary required.—Address, 1881, The Engineer Office. 1881 A

DRAUGHTSMAN WANTED, Experienced in Colliery Work. State age, salary, experience, and references.—THE BARGOED COAL CO., Ltd., Cardiff. 1902 A

ESTIMATOR or DRAUGHTSMAN, Prepared to Take up Estimating, WANTED IMMEDIATELY; experienced in Railway and Tramway Passenger Rolling Stock.—Applications should state age, experience, when free, and salary expected, to HURST, NELSON and CO., Ltd. Motherwell. P7150 A

FULLY QUALIFIED DRAUGHTSMAN REQUIRED, with good experience of Aerial Ropeway Designs and Construction.—Address, stating experience, age and salary required, 1953, The Engineer Office. 1953 A

IMPORTANT FIRM of Railway Rolling Stock Manufacturers in Midlands have VACANCY for FOREMAN of FORGE, SMITHY, and STAMPING DEPARTMENT. Applicants must have had extensive experience and be fully acquainted with most up-to-date methods.—Address, 1896, The Engineer Office. 1896 A

JIG AND TOOL DRAUGHTSMAN.—Capable MAN REQUIRED for Designing Jigs and Tools for parts produced in small quantities. Accustomed to lay-outs and planning operations. Must be good mathematician, quick worker, non-union. State age, experience, and salary.—Address, 1874, The Engineer Office. 1874 A

MECHANICAL DRAUGHTSMEN WANTED (with some Electrical Knowledge preferred). Men of first-class ability, workshop and technical training and sound experience; N.W. London. Good openings for first-class men.—Address, stating age, experience, and salary required, 1851, The Engineer Office. 1851 A

SENIOR DRAUGHTSMAN for Electrical Engineering Firm, with wide experience in the mechanical design of both A.C. and D.C. Machines. Applicant must not be under 25 years old and should write, giving full particulars of previous experience, age, and salary required.—Address, 1917, The Engineer Office. 1917 A

ASSISTANT FOREMAN SMITH REQUIRED, accustomed to Railway Carriage and Wagon Work; preference given to applicants who have had a mechanical experience; must be able to take out estimates for smithy work.—Address, 1892, The Engineer Office. 1892 A

TOOL-ROOM FOREMAN WANTED for Large Engineering Shops in North-East Coast district—Address, stating age, experience, and salary required, 1883, The Engineer Office. 1883 A

BLUEPRINTING MAN WANTED, to Take Charge of Manufacturing Engineers' Blueprint Room and Drawing Files. Knowledge of Hall's Rotary Machines and Modern Blueprinting, Photostatic, and Reproduction Processes essential, together with experience of routine filing and card indexing.—Address, stating age, experience, and salary required, P7132, The Engineer Office. P7132 A

ENGINEERING FIRM REQUIRE Smart MAN, experienced in Drafting and Designing Advertisements and Catalogues and capable of Taking Charge of Publicity Department. Apply, giving full particulars of training and experience and stating salary required.—Address, "PUBLICITY," Wm. Porteous and Co., Glasgow. P7105 A

SITUATIONS WANTED

BACHELOR of ENGINEERING, &c., with Varied experience in reinforced concrete and structural steel, WISHES to START with LONDON FIRM Engineers or Contractors at moderate salary.—Address, P7146, The Engineer Office. P7146 B

BUYER.—The MANAGER of a Large Engineering Works Purchasing Dept., who has an exceptionally wide knowledge of the markets of the country, DESIRES to NEGOTIATE NEW APPOINTMENT.—Write, Z. M., 613, c/o Deacon's, Leadenhall-street, E.C. 1941 B

CHIEF ENGINEER of Important Company, M.I.M.E., M.I.A.E., DESIRES CHANGE; 25 years' experience I.C. engines and motor cars; splendid organiser, highest qualifications.—Address, 1936, The Engineer Office. 1936 B

CIVIL ENGINEER (42), with Twenty Years' Home, foreign and colonial experience, DESIRES APPOINTMENT. Highest qualifications and references.—Address, P7062, The Engineer Office. P7062 B

ENGINEER, MANAGER or FOREMAN, Mechanical and electrical, REQUIRES POST; sound shop experience in steam, electrical, and gas, works maintenance and erection; age 40, married.—Address, P7142, The Engineer Office. P7142 B

ENGINEER (Mech. and Elect.) DESIRES POST, Maintenance or Works Engineer. Sound shop and D.O. experience, steam, gas, chemical plant, &c., works maintenance, erection, and control of labour.—Address, P7119, The Engineer Office. P7119 B

ENGINEER (Mechanical) WANTS RE-ENGAGEMENT, to take charge of factory plant, steam or gas engines, boilers, suction or pressure gas plants. Economy studied (own repairs).—Address, P7158, The Engineer Office. P7158 B

ENGINEER (32), Mech. (Elect. Knowledge). Keen, energetic, thorough works and D.O. training, apprenticeship 5 years Bellies and Morcom, Ltd.; production and commercial experience, DESIRES IMMEDIATE POST, Sales Engineers, Works Maintenance, or D.O.—Address, P7162, The Engineer Office. P7162 B

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For continuation of Small Advertisements see page 3

Condensing and Utilisation of Exhaust Steam in Locomotives.

No. II.*

THE question of the effect of direct or jet condensing systems of feed heating in putting grease or oil into the boiler is one of importance, and as far as locomotives are concerned has been the subject of considerable differences of opinion. Stroudley, than whom no locomotive engineer was more careful of his boilers, maintained that the turning of 20 per cent. of the exhaust steam into the tender had not been found to injure the boilers in any way. Some engineers have taken the precaution of fitting some form of oil separator, but others have dispensed with it. In his recent paper before the Institution of Mechanical Engineers, Professor Ed. Sauvage suggested that exact information on the point, after prolonged service, is of importance. M. Lacoin, of the Paris–Orleans Railway, reporting to the recent International Railway Congress, stated that "deleterious effects from oily matter in the boiler might be expected; however, no trouble from this cause appears to have been reported."

It would seem that the system employed, and more especially the volume and water surface area of the chamber in which condensation takes place, will affect the result. In systems such as Stroudley's, in which the tender received the exhaust steam, much of the oily matter would be left in it, and a very small amount would reach the boiler. At the other extreme, exhaust injectors deliver the whole of the exhaust steam which they receive into the boiler, and a grease separator is considered essential, and is always provided. Between these two lies the modern jet or contact condensing systems in which a condensing vessel of comparatively small size is used. In the case of these further information, after extended trial, is required.

In some of the surface condensing systems the water of condensation containing the oily matter is discharged on to the ballast, a plan not to be recommended, though it avoids any contamination of the boiler. In others the condensate is returned directly to the boiler, but if no oil separator be added, and its presence adds to the complication of the system, it would seem the better plan to divert it to the tender, provided that the level of the condenser is such that that can be done.

The exhaust steam injector, which is in effect a jet condenser, using a portion of the exhaust, is too well known to require description. Particulars of the latest form will be found in "THE ENGINEER" of March 31st, 1922. It need only be remarked that the high vacuum in the injector is beneficial in causing a reduction of cylinder back pressure.

Possessing certain characteristics of the feed water heater condensing locomotive, the Metropolitan type of condensing locomotive may be mentioned. These engines condense the whole of their exhaust intermittently. The main object in this case is not the saving of fuel, but the suppression of steam and smoke-box gases in underground tunnels.

The Metropolitan engines as built for many years are well known, and it is sufficient to say that the condensing arrangement was somewhat similar in principle to that of Kirchweger. The exhaust steam, on entering a tunnel, was "shunted" from the blast pipe into a large pipe which entered the top of the tank and was discharged upon the surface of the water. In the early trials it naturally resulted that the upper portion of the water in the tank was heated, and that there was no circulation. A smaller pipe with open upper end was then added. This end entered the mouthpiece of the larger pipe for a short distance, and the lower end, also open, dipped into the water of the tank. The greater part of the steam found an exit through the annular space between the pipes, and played upon the surface of the water, but sufficient steam passed into the small pipe and caused circulation of the water. The tanks, as in Kirchwegar's system, were provided with short chimneys or escape pipes to relieve the pressure, and underneath the footplate was a large discharging valve, through which the whole of the hot water in the tanks could be emptied into pits provided at certain stations.

The engines did not condense throughout their whole journey, and in "THE ENGINEER" of October 4th, 1895, page 327, will be found an interesting chart showing the sections of the line between Moorgate-street and Mansion House, where condensing was compulsory.

The tanks of the later engines had a capacity of 1200 gallons; nevertheless, at the end of each journey, before the complete Inner Circle was opened, the water was so hot that further condensing became impossible; and the contents of the tanks were then discharged into the pits, and fresh water taken. This method answered satisfactorily until the Inner Circle was completed, after which the engines ran continuously, and the frequent emptying of the tanks became inconvenient. From that time onwards the condensing became inefficient and the atmosphere of the tunnels suffered accordingly.

It is interesting to note that Dr. K. Clark, in Colburn's "Locomotive Engineering," stated that indicator diagrams, taken when the condensing apparatus was in use, showed that there appeared to be no back pressure in the cylinders.

A modified arrangement for condensing tank engines was fitted by Monsieur E. Polonceau to the Paris–Orleans engines which worked through the tunnels in Paris.* The exhaust pipe entered the tank at the top, and then dipped into the water, forming a loop which extended throughout the length of the tank near the bottom. Passing upwards in an inclined direction, the pipe discharged the remaining steam above the surface of the water. The steam which condensed inside the loop was drained from the lowest point by means of a small pipe which delivered into a cistern, this pipe being provided with a syphon bend to prevent the steam from escaping. On leaving the tunnel the contents of the cistern were emptied into a drain along the track. The other arrangements were, in general, similar in principle to those on the London Metropolitan Railway, but a supplementary cold water tank was provided, from which the injectors could supply the boiler when the water in the tanks became too hot, no pumps being used. In the case of these engines, the length of the tunnel traversed was comparatively short, and the engines did most of their work in the open, under conditions much less onerous than those under which the London Metropolitan engines worked. The services were analogous to those of the Great Northern and Midland suburban trains to Moorgate-street.

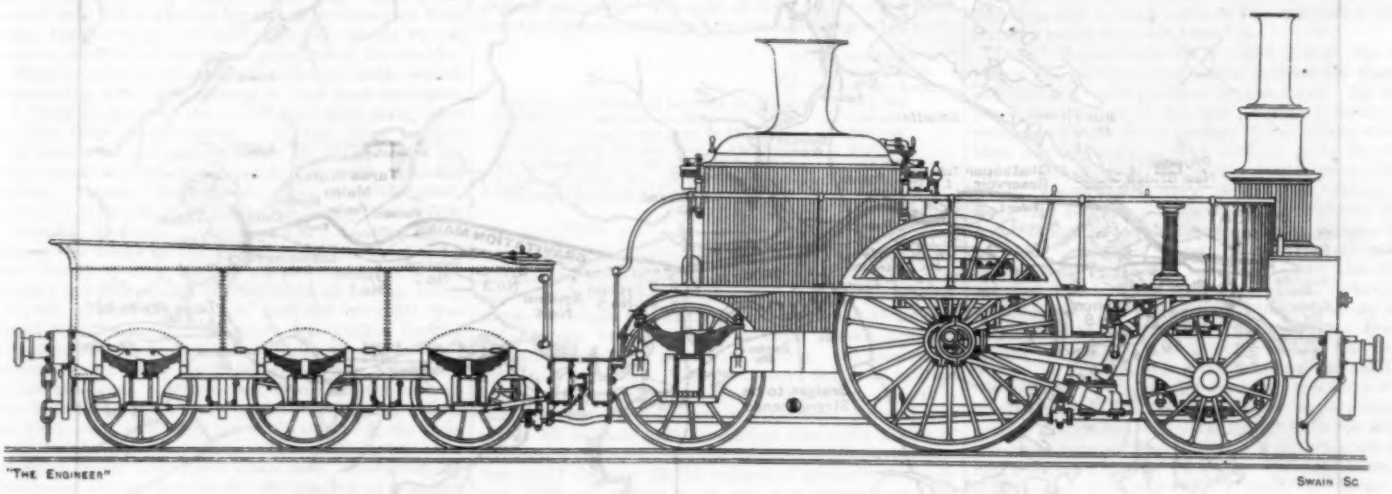


FIG. 7—EXPERIMENTAL CONDENSING EXPRESS LOCOMOTIVE, CONSTRUCTED AT ELSWICK IN 1848

B.—LOCOMOTIVES WHICH CONDENSE THE WHOLE OF THE EXHAUST STEAM TO EXPAND DOWN TO BELOW ATMOSPHERIC PRESSURE.

Only one practical attempt, as far as is known, has been made to apply condensing on this principle to a locomotive of the ordinary type with reciprocating pistons. This engine, illustrated in Fig. 7, was an experimental 2–2–2 express locomotive constructed by Messrs. W. G. Armstrong and Co., at Elswick, in 1848. The little available information with regard to it was contained in a lecture given in 1909 by Mr. Alfred Cochrane, who stated that the object aimed at was to obtain increased power by exhausting into a condenser. The boiler pressures in locomotives were at that time low, but with the higher pressures afterwards adopted the necessity for increasing the power by reducing the terminal pressure to a figure below that of the atmosphere became less urgent. Moreover, and this was the crux of the problem, the difficulty of maintaining the supply of cold water for condensing the steam proved insurmountable. The engine had driving wheels 7ft. in diameter, but the cylinder dimensions are not given. The boiler was of the vertical type, about 8ft. high. The condenser was in front, and the fireman stood at the back. The tender was of considerable size, to carry a large supply of water. Mr. Cochrane stated that "a considerable speed for short-distance runs was attained." The engine appears to have cost, with experiments included, about £2000. Nobody showed any desire to purchase it, and it was afterwards broken up, and some of the parts worked into other engines.

There are at the present time two experimental turbine condensing locomotives on the Continent. The first was put to work on the Swiss Federal Railways in 1920, and is one of the older 4–6–0 ordinary locomotives modified and reconstructed to enable a turbine and condenser to be applied. The turbine is placed transversely behind the buffer beam in front of the smoke-box, and the space underneath the boiler is reserved for the condenser. No particulars appear to be available with regard to the latter, except that the warm condensate is returned as feed to the boiler, and that the condensing water is supplied from the tender, which is fitted up with a water cooling roof to which the heated water is pumped. It is difficult to understand, in the absence of further details, how sufficient vacuum is obtained from a condensing and cooling arrangement within such a limited space. On short runs, such as those on which this engine has been tried, the cooling water can be changed at fairly frequent intervals, if necessary.

The Ljungström Swedish turbine locomotive is arranged with an air-cooling condenser. The air enters louvres in the side of the condenser vehicle, and by means of an elaborate system of fans, plays upon flattened ribbed tubes inside which the exhaust steam flows. The condensate drains into a large cylindrical vessel, and is returned to the boiler through a series of feed-water heaters. Though very complicated and requiring a considerable number of fans and pumps, the Ljungström condenser appears to be very effective, and if the costs of upkeep of its moving parts can be maintained at a reasonable figure, it bids fair to solve the difficult problem of locomotive condensing.

The condensing turbo-electric locomotive is a self-contained transportable electric power station, and since the power is derived from a steam turbine, these locomotives present the same difficulties in regard to condensing arrangements as the direct turbine engine.

In the Reid-Ramsay turbo-electric locomotive of 1910,† the exhaust from the turbine passed into an ejector condenser, and the mixture of condensate and condensing water was eventually delivered to a hotwell. As the turbine required no internal lubrication, the water of condensation was free from oil, and was returned directly from the hotwell to the boiler. The water evaporated by the boiler was therefore returned again and again, and the supply in the tank consisted of water which circulated for condensing purposes. It was caused to circulate by means of centrifugal pumps, driven by auxiliary steam turbines. The cycle was from the tanks through the first pump, and then through the condenser to the hotwell. From the hotwell it passed through a second pump to the cooler, which was placed in front of the engine, where it received the benefit of the current of air caused by the movement of the engine, also aided by a fan. After passing through the cooler the water was returned to the supply tanks. The draught for the fire was supplied by a forced draught turbine-driven fan, placed within the cooler, so that it delivered hot air to the fire, and at the same time assisted the current of air through the cooler.

The Ramsay turbo-electric locomotive, invented by Mr. D. M. Ramsay, of the Ramsay Condensing Locomotive Company, Limited, of Glasgow, and built last year by Sir W. G. Armstrong, Whitworth and Co., Limited, is provided with an evaporative

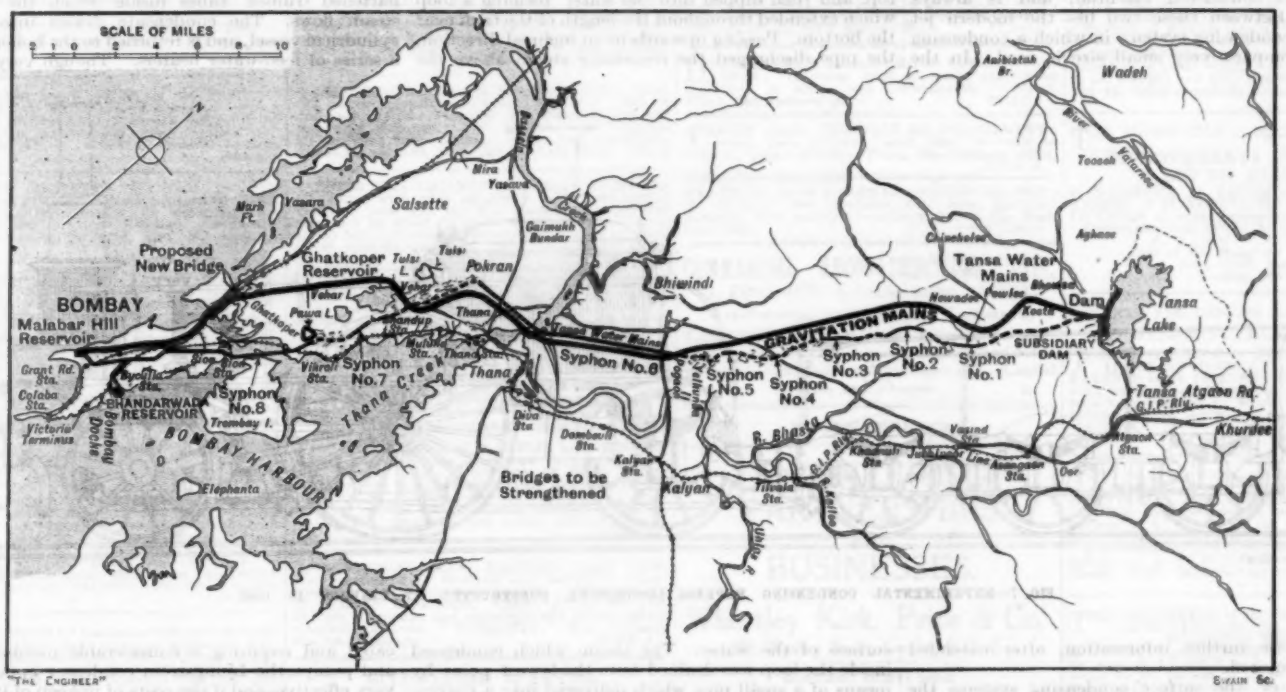
* No. I. appeared March 16th.

* "Revue Générale des Chemins de Fer," February, 1896.

† THE ENGINEER, July 8th, 1910.

condenser of a novel type. The boiler pressure is 200 lb. per square inch and the steam turbine driver a three-phase 890-kilowatt generator. The locomotive is of the 2-6-6-2 type in two units, of which the front unit carries the boiler, turbine, and generator, and the rear unit the condenser, cooling water tank and fuel. The exhaust from the turbine passes to the condenser, the condensate being delivered to the hotwell by means of a rotary pump, and is thence pumped back into the boiler. The tubular part of the condenser is mounted in a cage which revolves slowly through the water, and is also cooled by a current of air supplied by a large fan at the back of the rear unit. A vacuum of 27½in. is intended to be attained, and the cooling water tank carries 2200 gallons of water.

The successful solution of the difficult problem of producing a satisfactory condensing locomotive would do much to help the locomotive department of a railway in other directions than in the gain of thermal efficiency and consequent saving of fuel. The cost of water in some districts, especially if the supply be taken from a local authority, is high, and an engine which is able to use its water over and over again, and requires the replenishment of only a comparatively small loss, would be a most valuable motive machine. There are cases in which locomotive running sheds are situated at considerable distances from termini or important stations, solely owing to the cost of water at those stations, and the position of such locomotive depôts results in a large amount of unproductive light engine mileage. And even possibly of greater importance would be the lessened cost of upkeep of the boilers, which, in bad water districts, are an unceasing trouble and anxiety to those in charge of them. In many cases a condensing locomotive would be able to take its supply in a good water district, and return without the necessity of taking fresh water at the end of its outward journey at what may be a bad water station. On the other hand, an efficient condenser involves considerable complication, and the cost of maintenance of fans, pumps, and other moving parts, and avoidance of their liability to breakdown in service, might completely offset the advantages of such a system.



MAP SHOWING THE ROUTE TAKEN BY THE GRAVITATION MAINS FROM LAKE TANSA TO BOMBAY

Bombay Water Supply.

No. II.*

The Tansa Completion Works.

Since the completion of the Tansa extension works at the end of 1915, the war and other factors caused a large increase in population and an increase in the use of water and it was soon felt that a greater supply to the city was needed as quickly as it could be obtained. The Municipal Commissioner, in his letter of September 24th, 1918, drew the attention of the Corporation to this and strongly recommended immediate consideration of the question, at the same time asking for the appointment of a staff to carry out surveys and prepare plans for another water supply project. The Corporation gave its assent on the 28th November, 1918, to the appointment of a staff for the preliminary work of the project. The failure of the monsoon that year and a serious accident to the Tansa aqueduct in July, 1919, emphasised the urgency of the work, and made it obvious that the water supply was already inadequate for the reasonable needs of the people, and that the momentous scheme contemplated by the Government, City Improvement Trust, Port Trust and Municipality for the expansion of the city and its improvement could not become operative without a largely increased water supply, and that too at a comparatively early date. In June, 1920, within 6 months of the appointment of the staff for preliminary investigations, the Municipal Commissioner placed a report before the Corporation in which several projects for obtaining more water were described and their various merits weighed, those for utilising the tail water from the Tata hydro-electric schemes being of special interest. The latter, however, proved to be only of superficial attractiveness, for although a very much larger quantity of water of good quality became available from these sources its use would involve the installation of a large pumping plant with very heavy maintenance charges—7½ lakhs of rupees per annum—and did not compare favourably with the scheme recommended, which was to extend the Tansa scheme to its final limit at an estimated cost of 429 lakhs of rupees. This project, which was adopted by the Corporation on December 12th, 1921, has been called "The Tansa Completion Works." It provides for bringing into and distributing within Bombay the whole of the water which the Tansa catchment area can yield in years of normal rainfall, viz., 90 million gallons per day.

At first it was not proposed to bring in the whole of this quantity, but at the suggestion of Dr. Nadirshaw H. E. Sukhia, the Corporation resolved on May 4th, 1922, to bring in the entire supply by means of pipes, the whole distance from the lake to the city, and to abandon temporarily the use of the existing defective aqueduct until such times as it could be efficiently repaired and rendered safe against possible pollution. The question of determining the size of the pipe necessary to convey this enormous daily supply of water from the source to the city was an exceedingly important one and was referred to a committee of consultant engineers in Westminster, who, with the Municipal Hydraulic Engineer, agreed unanimously that it should be 72in. in diameter from Tansa to Pogaon and 57in. in diameter for the remainder, and also that two such pipes would be required.

Whilst preparations were being made to carry out this scheme the advisability of making the Tansa supply capable of still further expansion suggested an important modification. Under the scheme as approved, it was proposed to take up the existing 48in. and 50in. diameter pipe lines north of Pogaon and ulilise them south of Thana, putting the existing Tansa supply lines, for the time being at least, out of commission in the northern section. Investigations as to the possibilities of increasing the water supply from the vicinity of Tansa Lake were made, and it was found practicable at a comparatively low cost to divert a portion of the monsoon flow of the Vaitarna River into the Tansa catchment area by tunnelling through the intervening hill, constructing a low dam in the river bed, and strengthening and raising Tansa dam a further 25ft. By this means an additional 70 million gallons of water per day could be made available at a cost of 155 lakhs of rupees. Such being the case, the Municipal Commissioner on April 20th, 1922, placed the data before the Corporation and recommended the continuation of the 72in. diameter pipes to Powai instead of terminating them at Pogaon and their connection to the existing two 48in. mains at Ghatkoper, by means of a 60in. diameter riveted steel pipe laid from the 72in. diameter pipes at Powai; from the latter point they would be reduced in size to 57in. diameter and would be continued to Bombay. The supply thus provided would be capable of expansion from 90 to 160 million gallons per day without alteration to any of the existing or future main pipe lines. This modification was after consideration by the Water Supply Committee sanctioned by the Corporation on May 4th, 1922.

Before the pipes can enter Salsette, the Bassein Creek has to be crossed. There are now three large steel bridges which support the pipes carrying the supply across. It was originally proposed to substitute two 72in. diameter pipes for the existing pipes of 48in. and 50in. diameter, and to strengthen the bridges to carry the load, which would thus be more than doubled, and a contract was entered into with Messrs. Braithwaite and Co. for carrying out the work. Subsequent and further investigation, however, showed that such strengthening would probably be not only unsatisfactory but that the bridges might even then possibly not be safe. Also, owing to the design of the main girders, a grave element of doubt would always exist. In view of this, the Corporation decided to retain the existing bridges unaltered, leaving the existing pipes thereon undisturbed and to build new bridges to carry the two 72in. diameter pipes across to Salsette; at the same time making provision for the support of an additional 72in. main whenever it may be needed, and leaving space for a roadway 24ft. in width, to enable the Government, should it so desire, to link up the old Bombay–Agra trunk road again and so reduce its length by 13 miles. The work of building these bridges has been given to Messrs. Braithwaite and Co., and is estimated to cost about 34 lakhs of rupees. The works has recently been started and it is hoped to have it completed by the end of next year.

The main features of the Tansa Completion Works comprise:—

(1) The construction of an embankment with cuttings to form a track from Tansa to Bandra along which the pipes can be laid. This track is about 50 miles in length, by 30ft. in width at formation level, and is provided with a tramway of 2ft. 6in. gauge for the transport of pipes and materials. Three of the cuttings are large, extending from 1800ft. to 3400ft. in length and up to 45ft. in depth, a large proportion of which is through hard rock. The smaller rivers are crossed by masonry bridges, and road bridges and other accommodation are provided to give access for traffic across the track where required.

(2) The building of steel bridges across the Bassein and Bandra Creeks, the largest being 1800ft. long and 60ft. wide.

(3) The laying of two 57in. diameter steel pipes through the Island of Bombay from Mahim Causeway to Malabar Hill and Bhandarwada Reservoir.

(4) The manufacture, supply, transport, and laying of about 81 miles of 72in. diameter, 29 miles of 57in. diameter, and 3 miles of 60in. diameter riveted steel pipes together with the supply and erection of sluice valves, air valves, Venturi recording meters and other appurtenances.

(5) The remodelling of the distribution system of water supply within Bombay.

(6) The raising of Tansa Dam.

(7) The building of a new outlet well at Tansa Dam.

(8) The filtration of water from Tansa Lake.

* No. I. appeared March 16th.

(9) The removal of the villages within the Tansa catchment area.

(10) The supply and erection of a low-lift pumping installation to make up the loss of pressure from fluctuations in the water level of Tansa Lake, and

(11) The construction of a service reservoir of about 4½ million gallons on Sion Hill.

The tender of Messrs. Teju Kaya and Co., for the raising of the Tansa Dam was accepted on September 1st, 1920, by the Standing Committee, the specified time of completion being March, 1923. The work was started in January, 1921, and completed by June 10th, 1922, nine months within contract time, which enabled the lake to be filled last monsoon to the highest level the dam was designed for, and increased its available capacity to 35,000 million gallons. The completion of this work at a cost of 8,36,600 rupees marks the fulfilment of the original Tansa scheme and the first tangible step in the accomplishment of the Tansa Completion Works. The contract for constructing the new outlet well at the dam was placed with the Deccan Land and Building Company, which undertook to complete the work by the beginning of this year, for the sum of 4,31,888 rupees. The Tata Construction Company has secured the contract—amounting to 67 lakhs of rupees—for constructing the pipe track. The Corporation accepted its tender on August 31st, 1921, and the work was started a few weeks later. Progress has been severely hampered on account of malaria, which has troubled both labour and supervising staffs to a serious extent, and practically reduced the working year to one of only seven months. Notwithstanding this drawback almost half the work of this contract was completed by the beginning of February last. The greater part of the embankments is finished, ready for the pipes to be laid upon them and about one-half of the cuttings is completed.

The *Magnum opus* of the scheme is the manufacture and laying of the steel pipes. Very keen competition entered into the tendering for this enormous pipe line, which, for the weight of steel required—about 90,000 tons—is said to be the largest pipe line in the world—as Tansa Dam is the longest masonry dam in the world. Engineering firms specialising in steel pipe manufacture from all parts of the world vied with each other for this large undertaking. At the time tenders were received the steel market in Britain was in a very unsettled condition and in a ferment of labour trouble. Messrs. Braithwaite and Co., Limited, made a bold bid for the work by obtaining the support of Messrs. Dorman Long and Co., Limited, and placing the whole of the manufacture of the steel in their hands if they should prove successful. This resulted in their tender of 268 lakhs of rupees being accepted by the Corporation and the contract was placed with them on September 7th, 1921. Special factories have been built by these two firms and machinery specially designed and made to manufacture the pipes. At Dorman, Long and Co.'s works near Middlesbrough a building about 1000ft. in length has been built adjoining the mills in which the steel sheets for the pipes are made. This building has been equipped with the most up-to-date labour-saving machinery and appliances for the planing of a length of 700 miles of the edges of the plates, the drilling of the 40 million holes required for the rivets, and the milling of 300,000 corners of plates for scarfing.

Arrangements have been made for the manufacture and shipping of 2000 prepared plates every month—each plate being about 20ft. long by 7ft. wide and weighing about 20 cwts., or a total out-turn of about 2000 tons per month. On arrival in the Bombay Docks these plates will be transported by the G. I. P. Railway to Mulund, where they will be taken over a special railway siding into Messrs. Braithwaite and Co.'s factory for fabrication. This factory, consisting of five workshops and a power station, is equipped with the most modern tools and machinery for rolling the plates into cylinders, riveting them with hydraulic riveters into lengths and assembling the lengths into pipes about 56ft. in length. Sufficient machinery has been provided for completely manufacturing the plates into pipes within a period of 500 working days. It is hoped therefore to have the whole of the pipes laid and taken into use before the year 1926 is reached. The difficulty of transporting such a quantity of pipes of such large size, and laying them, especially without causing considerable public inconvenience in the Island of Bombay, is by no means small, but it is hoped to bring that phase of the work to completion and to increase the water supply within the time stated.

The question of the filtration of Tansa water is an intricate one, upon which much thought and time is being expended. It is hoped that before another year has passed an acceptable scheme at reasonable cost may be laid before the Corporation for consideration to purify the water supply to Bombay, render it safe against any epidemic of water-borne disease, and make it in quality second to none in the world. Several years have elapsed since consideration was given to the protection of the catchment area by the removal of all the villages therein. The Corporation approved of the recommendation to adopt this measure of safety and sanctioned the cost of removal of the remaining thirteen villages as long ago as 1912, and Government was requested to carry out the work but as yet none have been shifted though, it is hoped, that at least the smaller villages will be removed by the time the next monsoon breaks.

GENERAL.

At the present time the lakes supply about 50 million gallons of water per day, 4 millions of which is derived from Tulsi, 11 millions from Vehar, 32 millions from Tansa and 3 millions from Powai. The Tulsi and Powai Lake waters are now about to be filtered by mechanical filters. Vehar and Tansa waters are not yet filtered. Cumballa Hill is 135ft. above Bombay, Dongri Hill 20ft., and Malabar Hill 165ft. Malabar Hill Reservoir is 140ft. above Bombay. Bhandarwada Reservoir No. 1 is only 75ft. and No. 2 Reservoir only 60ft. above Bombay.

The average daily supply for various purposes during 1922 was as follows :—

	Gallons.
Bandra, Kurla, &c.	1,024,000
Shipping and docks	1,574,000
Railways	2,018,000
Mills and trades	4,499,000
Road watering	2,500,000
Gully flushing	500,000
Nightsoil depôts, latrines, urinals and sewer flushing	1,000,000
Municipal gardens, pumping stations, markets, slaughter-houses, fires, and other municipal requirements	1,600,000
Total	14,715,000

Say, 15 million gallons per day, leaving 35 million gallons per day for domestic purposes. The present population is about 1,200,000, consequently the average quantity per head per day available for domestic supply is now 29 gallons per head per day.

The greatest demand for water is from 6 to 9 a.m., and 5 to 8 p.m., about 75 per cent. of the total amount for domestic purposes being required for use during those hours. In other words, the rate of demand during that period is about 4 million gallons per hour. The rate of demand for water used for other purposes is shown in the following table :—

	Maximum rate of consumption in gallons per hour.
Shipping and docks, 75 per cent. in 12 hours	240,000
Railways, 75 per cent. in 12 hours	100,000
Mills and trades, 75 per cent. in 12 hours	325,000
Road watering, 100 per cent. in 8 hours	315,000
Gully flushing, &c., 100 per cent. in 8 hours	63,000
Latrines, urinals, &c., 100 per cent. in 24 hours	40,000
Municipal gardens, &c., 100 per cent. in 8 hours	200,000
Total	1,283,000

The rate of consumption during the hours of maximum demand which, for trades, railways, docks and municipal requirements, &c., extends from eight to twelve hours per day, is therefore about 1¼ million gallons per hour, making a total requirement of 5¼ million gallons per hour during the period of maximum demand. That is to say, about 33 million gallons of the daily supply of 50 million gallons is taken during the six hours of maximum demand and about 40 million gallons during the eight hours of maximum demand. Of the 52,800 buildings in Bombay (1921 Census) 33,100 consist of ground-floor only and 7600 of ground-floor and one upper-floor. In other words, 77 per cent, of the buildings in Bombay are buildings of less than three storeys.

The quantity of water required per head for domestic purposes is the same, whether for those living in two storied buildings or higher buildings. Therefore, the total quantity of water required for domestic purposes in one and two-storied buildings may be taken at 77 per cent. of the amount available for that purpose, or 23 million gallons per day, of which 21 million gallons is drawn off at ground-floor level. About 14 millions of the 15 million gallons per day used for other than domestic purposes is also drawn off at ground-floor level. So that 35 million gallons per day is drawn off at ground-floor level, and nearly all of this amount within the eight hours of maximum demand. Under the Municipal Act the Corporation is under no liability to supply water to any premises under pressure. Its liability ceases on supplying water to the premises and it rests with the owner to make his own arrangements to lift and distribute the water throughout his buildings. The Tansa Completion works are being designed to give a constant supply at a pressure of 70ft.

There are about 700 municipal roads and 200 private roads in Bombay. In many of the private roads there are no water mains laid. Many of these roads are very long and the loss of pressure due to the long length of small service pipes causes much inconvenience and discomfort. If a fire should occur in many of these private streets, it would be difficult to extinguish, as there are no water mains nor hydrants for fire extinguishing. There are no powers under the Municipal Act to enforce water mains being laid in private streets. There are 5300 fire hydrants and 240 miles of municipal water mains laid in public roads. The waste of water in municipal water mains, service pipes, hydrants, and other street adjuncts was reduced from 28 per cent. of the total supply in 1896 to 5 per cent. in 1917, and remains at that percentage.

Institute of Metals.

No. III.*

THE other papers read and discussed on the second day of the annual meeting of the Institute of Metals on Thursday, the 8th inst., are reported below.

The paper next in order dealt with "The Ternary System Copper-Aluminium-Nickel," and was presented by Mr. Charles R. Austin and Mr. A. J. Murphy. We summarise it briefly below.

THE TERNARY SYSTEM COPPER-ALUMINIUM-NICKEL.

There is no recorded determination of the thermal equilibrium diagram for the copper-aluminium-nickel alloys. Read and Greaves have examined, chiefly from the point of view of mechanical properties, the alloys at the extreme copper and aluminium corners of the diagram. No systematic liquidus determinations have been made. Guillet has observed the effect of small additions of nickel on the constitution of the industrial copper-aluminium alloys. Several investigations of aluminium alloys have included those containing small amounts of nickel and copper, but the metallographic work has not been extended to a study of the ternary equilibrium diagram. The present research originated in some preliminary experiments—by thermal and microscopic analysis—on alloys with 0 to 10 per cent. aluminium, and 0 to 10 per cent. nickel. Slow cooling of most of the alloys in this region has been shown by Read and Greaves to result in the separation of a second constituent from the homogeneous a solid solution. After a series of observations had been made, the authors decided that to determine the nature of the constituents of the slowly cooled alloys, it was necessary to have a fuller knowledge of the ternary diagram. With this end in view, cooling curves have been taken on about 250 alloys covering the whole ternary diagram, the determinations being most numerous in the area 0 to 20 per cent. aluminium and 0 to 20 per cent. nickel. The alloys have also been examined microscopically.

From the data obtained, the authors have been able to establish the liquidus surface for the complete system, and to deduce with a fair degree of certainty the solidus for alloys rich in copper and nickel, and with aluminium contents ranging from 0 to 20 per cent. on the copper-aluminium side, and 0 to 32 per cent. on the nickel-aluminium side.

Dr. J. L. Haughton congratulated the authors on an excellent piece of work, but he was very much surprised to notice that they had not made any reference to the extreme difficulty in finding the liquidus, and he had come to the conclusion that the authors really had not found it.

Dr. D. Hanson said he thought that in one or two places the authors had made statements that were not perhaps quite justified by the facts. In the first place, he wished to ask one or two questions with reference to the investigation of the alloys with very high melting points. The authors gave the cooling curves for alloys with melting points over 1500 deg. Cent. Those were very difficult to obtain. The work had been done with platinum-rhodium thermocouples, and he would like to ask the authors if they kept an individual check on their thermocouples, and if they could say to what extent the thermocouples deteriorated after each heat. Further, he would like to ask the authors what refractory shields they used to protect the thermocouples from the melts. The most serious criticism he had to offer was as to the method of determining the solids with the system. The samples were not really in a suitable condition for use in quenching experiments for solidus determinations. He thought the research was the most comprehensive liquidus determination that had ever been carried out in the ternary system.

Professor Edwards added that the great point about the work was the remarkable difficulties the author had encountered in measuring observations at the high temperatures involved.

Mr. Murphy, in replying to the discussion, said, with regard to the question of the determination of the solidus from cooling curves, that it was not as final and as determinative a method as an actual prolonged annealing and quenching, but some of the difficulties could be got over, as was indicated in the paper, by comparing valuations obtained by that method with a known system. The points which Mr. Stockdale had raised with regard to the changes in the solid copper aluminium alloys did not bear very closely on the liquidus determinations. With regard to the alloy with 14 per cent. of aluminium and no copper, the authors were prepared to accept Mr. Stockdale's figure. They considered that his work was very interesting, especially in view of the remarks of Dr. Hanson, in showing how useful a direct cooling curve could be in fixing the solidus of the alloys.

Colonel L. T. Belaiew then read his paper, "The Inner Structure of the Crystal Grain as Revealed by Meteorites and Widmanstätten Figures."

CRYSTAL GRAIN.

In this paper various octahedral sections are described, and their relation to the Widmanstätten figures emphasised. A method is described for the determination of the position of a secant plane (ω, ϕ) in space, with reference to the angles A, B C, and D, between the four sets of lines of the Widmanstätten figures. The application of that method to the case of the author's alloy No. 8 with the well-developed Widmanstätten structure is shown, and a diagram of a section with about 20 grains variously oriented is given.

The importance of that method for the crystallography of metals is emphasised, and the suggestion brought forward that the occurrence of Widmanstätten figures in metals crystallising in the regular system is associated with the face-centred cubic lattice.

Professor Carpenter said the paper was of a new type as far as the Institute of Metals was concerned. The author had brought forward a striking and novel method of investigation which opened up a fresh field of research.

The two papers by Mr. A. L. Norbury, "The Hardness of Annealed Copper" and "The Hardness of

* No. II. appeared March 16th.

Certain Copper Alpha Solid Solutions" were taken together.

THE HARDNESS OF ANNEALED COPPER.

The object of the present research was to obtain a more definite expression for the Brinell hardness of copper.

It is well known that when copper is worked its hardness is increased, and when this worked copper is annealed above about 300 deg. the hardness falls again. The hardness does not, however, fall to a constant value for all annealing temperatures above 300 deg., but falls rapidly at first and then more slowly, and is still falling slightly even at 900 deg. It is obvious, therefore, that a definite expression for the hardness of copper must take into account the annealing temperature, or some factor which is being influenced by the annealing temperature.

Bassett and Davies* have published results for cartridge brass showing: (*a*) a progressive fall in Brinell hardness, and (*b*) a progressive increase in grain size, after annealing the cold-rolled brass at progressively increasing temperatures. They conclude from their results that a definite expression for the hardness may be obtained by taking into account the grain size. In measuring the Brinell hardness of copper a second series of variables is, of course, introduced if the diameter of the Brinell ball or the load used is varied. These variables are, however, accounted for in a very simple manner if the results are plotted according to Meyer's formula $L = a \cdot d^n$, as has been done in the present paper.

The results obtained in the present research, when plotted according to the above formula, permit the deduction of a hardness value which is constant for all specimens of worked and annealed cathode copper, provided complete recrystallisation has taken place. The results are presented in a series of tables.

THE HARDNESS OF CERTAIN COPPER *a*-SOLID SOLUTIONS.

The object of the research was to measure the hardnesses of certain copper-rich *a*-solid solutions in order to compare the relative effects of different elements in increasing the hardness of copper; the ultimate object being to see if an element's "hardening" capacity could be correlated with one of its other atomic properties, such, for instance, as its atomic volume. The hardnesses of alloys of copper containing various percentages of aluminium, silicon, manganese, nickel, zinc, silver, and tin, in solid solution, have been measured.

The expression Log. $a + n$ (from Meyer's formula $L = a \cdot d^n$) has been used to express the Brinell hardness of the alloys, since it gives a hardness value which is independent of the previous mechanical and heat treatment—within certain limits—as discussed in the author's paper on "The Hardness of Annealed Copper." It has also been possible to correlate the Log. $a + n$ values so obtained with the sclerescope hardnesses of the alloys

Mr. Hugh O'Neill, who said he had been engaged in similar work to that described in the papers, commented on the fact that the Brinell number first of all rose as the load increased. In other words, the Brinell number increased with the rise of testing load, passed through a maximum and then fell. That fact had, he thought, been established in the case of other metals. The ultimate hardness number was independent of the original condition of the specimen.

Mr. J. G. S. Primrose said the work of the author had gone a long way towards demonstrating the usefulness of carefully conducted hardness tests to the worker in copper. He noted that Mr. Norbury recommended the use of Meyer's formula to give a simplification of hardness numbers. People were beginning to realise that the number was really a load value expressed in kilogrammes per square millimetre similar to tons per square inch in other tests.

Mr. Norbury, in reply, said Mr. O'Neill had reached the conclusion that the Log. $a + n$ value was independent of the initial cold work. That was not his experience. He found that with severe cold work it increased, and Kürth had obtained the same result. He had been carrying out experiments with the object of connecting the Log. $a + n$ value and the n value with the ultimate stress, and there were already indications that useful results might be obtained.

Several papers were read and discussed at the final session of the meeting on the afternoon of March 8th.

Mr. R. Genders presented a short note on a new form of magnifier hammer to be used in connection with the sclerescope hardness test. In this hammer balls of either 1 mm., 2 mm., 3 mm., or 4 mm. diameter are used in place of the usual group.

Dr. R. H. Greaves welcomed Mr. Genders' magnifier as a very useful development of the sclerescope test. He understood that trials had already been made with a 3 mm. ball hammer, and that the results had been very satisfactory. The method ought to be useful for specification requirements.

Dr. A. G. Gwyer thought it should be possible not only to construct a hammer to give a constant number, but also a super-magnifying hammer in which only the size of the ball had to be altered to give the machine a very wide range of usefulness. A standard machine was wanted, and he would like to know if the author had been in communication with makers of the machines.

Commander Venner said he had been associated with Mr. Genders in the practical work, having been responsible for carrying out tests on Admiralty brass cartridge cases, and he could state very clearly that the ball hammer which Mr. Genders had invented was a decided improvement, in its action, on the hammer used formerly. The old hammer had varying contours and gave varying results. In an extensive trial he had personally conducted with brass cartridge cases the improvement had been clearly brought out, and he hoped Mr. Genders' work would be of value from the Admiralty inspection point of view.

Mr. Tritton, who dealt with the same subject at a previous meeting of the Institute, said Mr. Genders appeared to have overlooked the fact that the magnifier hammer could be rectified to give accurate results. He would lay stress on the need, to ensure accurate work with the sclerescope, for the hammer to give rebounds registering with the standard hardness test block. It was of greater importance to obtain accurate hardness testing blocks than to alter the hammer, and he suggested that Mr. Genders should study that aspect of the subject.

Mr. Genders, in his reply, said he had not approached the instrument makers, as he deemed it preferable to have a discussion on the subject first. There was no such thing in existence as a standard hardness block. Hammers were turned out in an unsatisfactory manner, but it was obviously a difficult task to standardise hammers which varied in diameter, and it would mean that manufacturers would have to carry large stocks and make numerous tests of hammers with standard blocks.

A paper on "The Density and Hardness of the Cast Alloys of Copper with Tin" was brought up by Mr. Harold Heape.

CAST ALLOYS OF COPPER WITH TIN.

The object of the present research has been to amplify and correct the earlier results, and to provide the founder with determinations which have been made under conditions as nearly as possible identical with those obtaining in the foundry. An attempt has also been made to establish a relationship between density and hardness.

Two important properties of the alloys of copper with tin have been determined, namely, the density and the hardness, and, in general, it appears that the hardness varies with the density. The alloys with a high hardness number possess a comparatively high density, and, conversely, alloys with a low hardness number possess a low density. A comparison of the density curve and the hardness curve of the sand-cast specimens shows that, for a change in direction of the hardness curve, there is a corresponding change in the density curve. This is well marked in an alloy containing 72 per cent. copper, peaks occurring with this composition in both curves. With other compositions where peaks occur in the hardness curve—that is, at 50 per cent., 33 per cent., and 25 per cent. copper—there is a change in the rate of fall of the density curve, indicated by a flattening of the curve with these compositions, thus showing a tendency to increase in magnitude. The conclusions which may be drawn from this paper are, the author ventures to suggest, as follows:—(1) That the algebraic sum of the changes in volume, occurring on alloying and during subsequent solidification, is in every case negative, or, in other words, results in contraction; (2) that though the density and the hardness are related, it is not possible to determine the exact relationship by means of determinations made on cast alloys; (3) that the hardness curve obtained by the author does not fit in with the hardness theory of Kurnakow and Zemczuzny; (4) that it is very difficult to obtain sound castings with the copper-rich alloys.

Professor Thomas Turner said that any series of tests of the kind undertaken by the authors must include quickly cooled and slowly cooled materials, and the author had recognised that fact. It should be borne in mind, however, that any experiments that were made on the density and hardness were merely side lines in a general inquiry, an inquiry of an exploratory character, because nothing had been done with this series of alloys in that direction before.

Dr. Hanson pointed out that a determination of the density of chill castings could not be regarded as giving the density of the alloy composition itself. There was in all castings a certain degree of unsoundness.

In a short reply, Mr. Heape insisted that as the hardness curve which he obtained did not fit in with the theory of hardness to which reference had been made, he thought he was justified in challenging its soundness.

The next paper to be discussed was that by Dr. Hanson and Miss Marie L. V. Gayler, "The Heat Treatment and Mechanical Properties of Alloys of Aluminium with Small Percentages of Copper." A brief summary is given below.

ALLOYS OF ALUMINIUM WITH SMALL PERCENTAGES OF COPPER.

This paper forms part of a research carried out for the Engineering Research Co-ordinating Board, Aeronautics Research Committee (Materials and Chemistry Sub-Committee), which has granted permission for the present publication. The research constitutes a continuation of the systematic study of aluminium alloys, which has long been in progress in the Metallurgy Department, National Physical Laboratory, under the direction of Dr. W. Rosenhain, F.R.S.

The conclusions reached are that:—(1) Copper-aluminium alloys containing 0 to 2 per cent. of copper are not appreciably affected by quenching from 500 deg. Cent. and subsequent ageing. (2) Alloys containing 2.5 to 5 per cent. of copper are profoundly affected by this form of heat treatment. The strength of a rolled and annealed 5 per cent. alloy is increased from 12 tons per square inch to 23 tons per square inch as a result of quenching and ageing. At the same time the elongation is high. (3) Further treatment of quenched and age-hardened material, at a temperature higher than the normal, does not improve the tensile strength, but in some cases the Brinell hardness is increased.

Dr. Gwyer commented on the remarkable improvement in the properties of the material which the work of the authors revealed. He would like to ask how the properties of the alloys treated compared with those of the "Y" alloy when in larger bulk. In the case of the "Y" alloy the effect of chill appeared to be of paramount importance. He would anticipate that the properties with sand castings of considerable size, slowly cooled, would be better than with the "Y" alloy.

Mr. Clarke raised one or two points of practical importance. His experience in obtaining good and bad castings suggested that in work of the kind described in the paper special attention should be given to the purity of the materials used and, above all, care taken to obtain perfectly good sand. When castings were annealed and simply air-cooled it was important they should be suspended and not allowed to come into contact with the floor, the effect of which was to produce cracks down one side.

The paper by Miss Marie Gayler, "The Constitution and Age Hardening of the Ternary Alloys of Aluminium with Magnesium and Copper," elicited a short discussion, and an American contribution by Mr. N. B. Pilling and Mr. R. E. Bedworth on "The Oxidation of Metals at High Temperatures" was then taken.

This concluded the meeting.

* Bassett and Davies, "Transactions" of the American Institute of Mining and Metallurgical Engineers, 1919, vol. lx., p. 637.

A Development of the Cyc-Arc Welding Process.

In our issue of July 1st, 1921, we described in some detail the apparatus employed in and the method of operating the Cyc-arc welding process. It will be remembered that in our article we explained that the system, as originally introduced, was used for welding brass or bronze studs to steel plates. As a matter of fact, the idea of the machine arose from the desire of the Admiralty to discover some means of being able to attach objects to bulkheads without having to piece the latter. The solution of the problem was entrusted to Mr. L. J. Steele, M.I.E.E., the Chief Electrical Engineer at Portsmouth Dockyard, and he, in conjunction with his chief assistant, Mr. Harold Martin, A.M.I.E.E., and Mr. Andrew Edward McCarthy, devised an apparatus which has many interesting and ingenious features. Briefly explained, the system depends for its success on the fact that the electric arc is allowed to play between the parts to be welded for exactly the correct period of time, the two pieces of metal which it is desired to unite being then brought into intimate contact and held there, by means of a spring. For different sizes of studs and for different kinds of metal it is necessary for the arc to play for different periods of time, and the variation is made in the apparatus itself by simply altering the position of a cam.

We explained the whole equipment so fully in our former article that it will only be necessary in the present instance to say that the stud, which is held in a holder somewhat resembling an ordinary expanding chuck, is secured in the desired position on the bulkhead by a tool furnished with two powerful electro-magnets. The chuck, which is furnished with a central reciprocating member, operates under the influence of two forces, (*a*) a spring, and (*b*) a solenoid. The stud, inserted into the chuck, is held tightly against the bulkhead by the action of the spring. When current is allowed to flow through the winding of the solenoid the effect is to overcome the resistance of the spring and to draw the stud away from the bulkhead, thus striking an arc. After being allowed to play for a very limited period—a fraction of a second for a ¼in. stud—the electro-magnet of the "chuck" is de-energised, with the result that the spring immediately re-asserts itself and presses the heated end of the stud against the heated plate, the current being then cut off. As a matter of fact, both stud and plate are actually melted in the immediate vicinity of the point of contact with the result that there is a definite weld, the two metals mingling and forming an alloy. On test it has been found impossible to pull the studs away from the plate; the stud will elongate and break first. The timing of the duration of the arc and of the switching on and off of the current are brought about by a separate clockwork-driven control gear, which was illustrated and referred to at length in our former article, so that we need not describe it again in the present instance. It is only mentioned, in fact, because exactly the same control gear is used with the later development of the system which it is the purpose of this article to explain. It may be said here, however, that the length of time occupied by the full cycle of operations in the original control mechanism was 7 seconds, and that it had an arc-timing adjustment up to 3 seconds. In a similar mechanism since devised the time occupied by the full cycle of operations has been reduced to 1½ seconds.

The original Cyc-arc equipment was not intended to be suitable for diameters of brass or bronze studs exceeding ¼in. Furthermore, when the attempt was made to weld steel to steel, it was found that the spring applied the pressure so suddenly that the molten steel tended to be ejected in all directions, with the result that the weld was defective. This effect may possibly be due to, or at any rate accentuated by, electro-magnetic action.

The inventors thereupon set to work to devise an entirely new machine, and they finally determined to use compressed air to bring about the pressure on the weld. Their first efforts with this new form of power did not meet with success, as it was found that the pressure was still applied too quickly and violently. The very simple expedient of wire-drawing, however, immediately solved the difficulty, and now, by restricting the orifice in the supply nozzle—to a varying extent depending on the nature of the work in hand—perfectly successful welds can be made. With the present machine it is possible not only to weld dissimilar metals and alloys together but—what is, apparently, a matter of greater difficulty—to do the same thing with identical metals. We are informed that success has been achieved with every metal and every alloy which has yet been tried. It is, apparently, an advantage if the two pieces to be welded have different melting points, and it is for that reason that it is easier to weld dissimilar than similar metals.

But to say that one is easier than the other is not to say that the results in the more difficult are in any way unsatisfactory. It is explained, moreover, that the pieces welded need not be of the same shape or diameter, and studs of any shape can be welded to plates of astonishing thinness. We have seen examples of studs welded quite satisfactorily to very thin tinned sheet plate, or "tin" as it is called colloquially, and we have ourselves witnessed the two following examples:—(*a*) A piece of mild steel ¼in. in diameter welded to a round steel bar, of identical composition, and 1in. in diameter; and (*b*) a brass stud ¼in. in diameter welded to a plate of bronze made up of copper 2.9 parts, tin 1.75 parts, and zinc 0.88 parts, and only about 1/16in. thick. This latter weld was effected with a Cyc-arc equipment of the

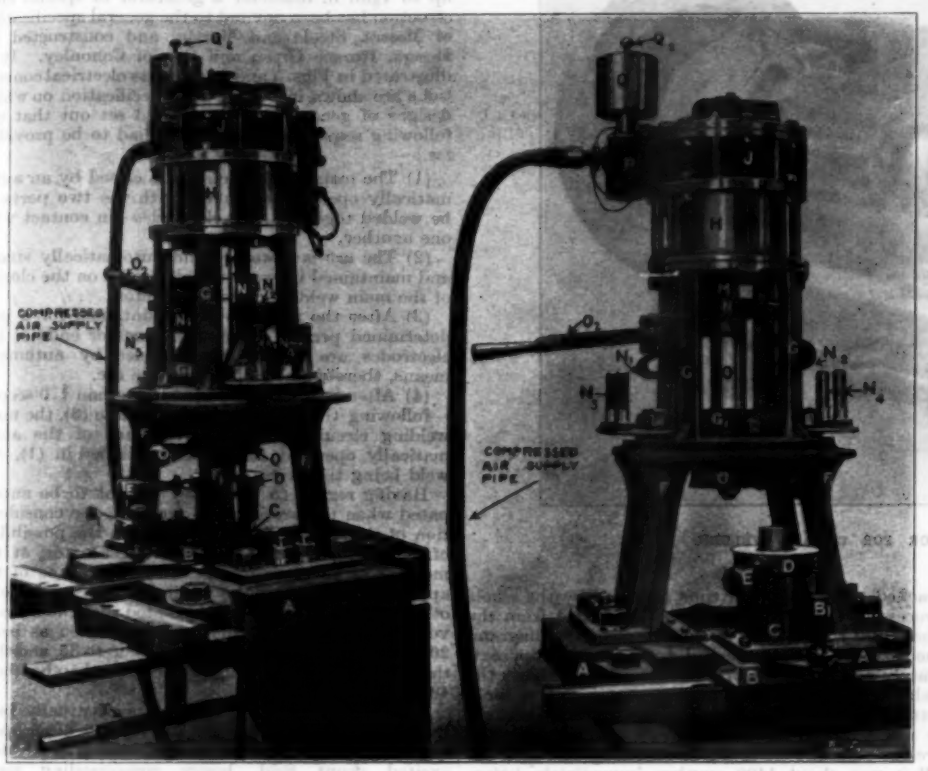
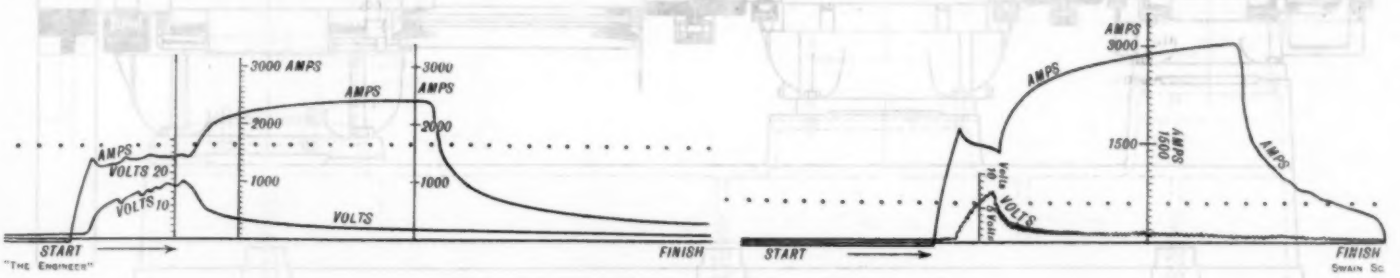


FIG. 1—NEW TYPE OF CYC-ARC WELDING MACHINE

original type, but the steel to steel weld was made with the new machine.

At present the new machines have been developed with a specific purpose, namely, to weld round high-speed steel blanks to round mild steel shanks for the purpose of manufacturing twist drills or other central shank tools, the object being to save expense by arranging that only the operating portion of the drill shall be of the harder and more expensive material. There are, of course, numerous other possible applications, among which is that to cutting tools other than twist drills, the welding of special steel tips to coal cutter picks, and of mild steel extension shanks to existing short tools—in which directions a considerable amount of success has been achieved—but hitherto there has not been time to evolve



FIGS. 3 AND 4—OSCILLOGRAPH RECORDS OF CYC-ARC WELDS

modifications of the machine for special purposes. Up to now two sizes of machine have been made, the larger having an air cylinder 6in. in diameter, and the small one of 4in. in diameter. The larger is specially intended for drills from ¼in. to 1¼in. in diameter, though actually it has, we understand, successfully dealt with metal 1½in. in diameter. The larger of the two machines is illustrated in Figs. 1 and 2.

It consists of a cast iron bed-plate A, which is furnished with a slide B, on which is mounted a sleeve C having a central vertical hole in it. Fixed to the top of the sleeve is an expanding chuck D made of phosphor-bronze, which can be opened or closed by means of a handle E screwed into the socket E_1. This chuck is intended to hold the cylindrical mild steel shanks, and the arrangement of the top of the sleeve is such that it can receive any chuck within the range of the machine. The slide B is provided with a handle B_1, by which it can be reciprocated by hand in guides formed in the base plate, and there is an adjustable stop up against which it abuts, and by means of which the shank can be brought immediately beneath the high-speed steel blank to which it is to be welded. Although not shown in the drawing and not visible in the half-tone engraving, flat plaited copper leads are securely fastened to the underside of the slide for carrying current to the latter, and hence, of course, to the chuck and to the mild steel blank. Bolted to the bed-plate is cast iron pedestal F F_1, to the top of which is bolted the distance piece G, which is a gun-metal casting, and at the lower end of which is formed a guide ring G_1, the purpose of which will be explained in due course. Between the cast iron supports and the gun-metal casting there is a ring of insulating material, and the bolts are taken through insulating bushes so that there is no electrical connection between the two. Bolted to the top of the gun-metal casting G is a solenoid H, and above that again is an air cylinder J. Working in the cylinder is a piston K, which is furnished with a phosphor-bronze piston-rod K_1. To the lower part of the latter is connected a circular soft iron solenoid core L, which has screwed to it a phosphor-bronze extension piece M. The lower end of this extension piece is gripped by the clamp N to which are bolted the flexible plaited copper leads N_1 and N_2, which are connected to the terminals N_3 and N_4. A hole is bored in the lower end of the extension piece M to receive the shank of the hollow chuck O, which can be operated by the handle O_1, and which is intended for holding the high-speed steel blanks from which the twist drills are formed. The chuck is held accurately central by being passed through a hole formed in the guide ring G_1, to which attention has already been called, but the fit of the chuck in the guide permits of the ready up and down movement of the latter.

From the top of the air cylinder J there runs a passage way J_1, which communicates with the air valve P. The latter, which is of the piston type, works vertically, and is furnished with a spindle P_1, the upper end P_2 of which is composed of soft iron, and forms the core of the solenoid Q. Air under pressure is supplied through the nozzle R, which is furnished at its discharge end with a small orifice R_1, the diameter of which is considerably smaller than that of the bore of the nozzle itself and which is varied to suit different classes of work.

Before going on to describe the actual process of making a weld it will be best to refer again to the timing mechanism on which the whole process really depends. The apparatus was, as we have said, so fully described in our previous article that there is no need to go into it in great detail at the present time, but in order to make this article complete in itself a certain amount of explanation is necessary. Briefly, then, the mechanism, which is driven by a

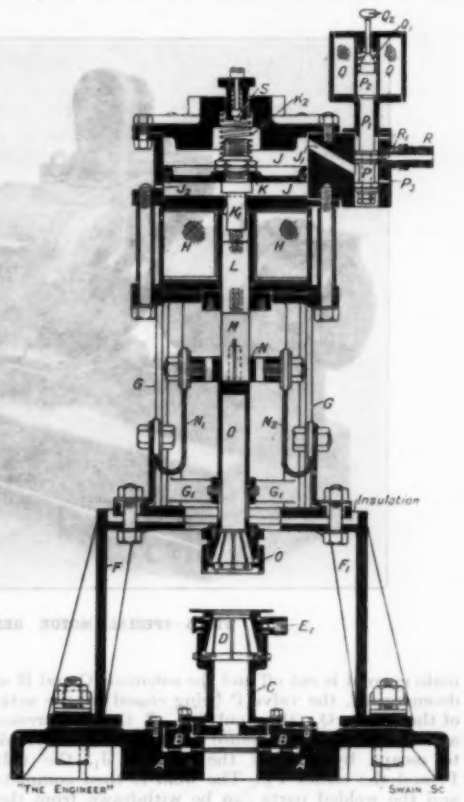


FIG. 2—SECTION THROUGH CYC-ARC WELDING MACHINE

very accurately made piece of clockwork, identical with that used for driving high-class gramophones, is designed with the purpose of (*a*) supplying current for working the arc-striking solenoid; (*b*) switching on the main working current; (*c*) switching off the current after a predetermined time, which is done by means of an adjustable cam, so that the period during which current is flowing can be varied at will, the actual breaking of the current being done by contactors of special design; and (*d*) switching current on and off the air valve operating solenoid.

We are now in a position to understand how a weld is made. First of all, a high-speed steel blank is inserted into the chuck O, which is furnished with a lever O_2 for raising it by hand so as to facilitate the process, and a mild steel shank is inserted into the chuck D. The slide B is then pushed by the handle B_1 until it abuts against the stop, referred to above, so that the shank is brought immediately and concentrically beneath the blank. All being now ready, the process of welding is started by simply pressing a push button. Thereafter the control mechanism takes charge and the following sequence of operations is performed:—Current from separate sources is simultaneously supplied to the main solenoid H and to the main welding circuit through the plaited copper leads N_1 and N_2. The result is that the chuck O and with it the hard steel blank are drawn smartly upwards so that an arc is formed between the blank and the shank, the distance travelled, and hence the length of the arc produced being controlled by the adjustable spring stop S, the spindle of which passes through the top cover of the air cylinder, and against the base of which the top of the tail end of the piston-rod strikes.

After an interval, which is determined by the

diameter of the metal being welded, but which is, in any case, very short, the air supply solenoid Q is energised. The result is that the valve P is drawn upwards and pressure air is permitted to enter the top of the cylinder J, forcing down the piston K and consequently the chuck O, so that the blank is held tightly against the shank and the weld is consolidated. When the piston K is forced down the air underneath it is expelled through the passage J_2, and is, hence, not compressed so as to form a cushion.

Again, after an interval which is also very short and which can be regulated to suit the work, the

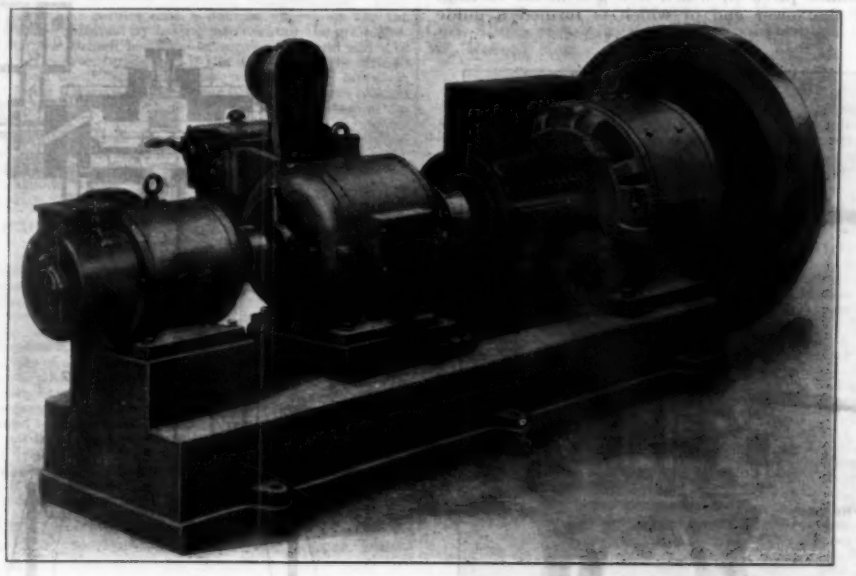


FIG. 5—SPECIAL MOTOR GENERATOR FOR CYC-ARC WELDING

main current is cut off and the solenoids Q and H are de-energised, the valve P being closed by the action of the spring Q_1, thus cutting off the air pressure and allowing the pressure air in the air cylinder to escape by way of the passage J_1, the valve P, and the outlet P_2. The weld is then completed and the welded parts can be withdrawn from their chucks, the levers O_1 and T being raised for the purpose.

This completely automatic action is found to be quite satisfactory in the case of the smaller welds which chill rapidly; but when welding bars of larger diameter, which require a relatively large amount of heat, and which, therefore, chill at the weld much more slowly, the inventors prefer to remove the solenoid spring Q_1 so as to ensure that the air pressure is maintained for a longer period after the completion of the weld. When operating in this manner, that is to say, without the spring, the valve P is closed by hand by pressing the knob Q_2, which is formed on an extension of the valve spindle or plunger. As can well be imagined, very heavy currents have to be dealt with, which, of course, increase when blank and shank are brought together, when they may reach several thousands of ampères. We reproduce in Figs. 3 and 4 two oscillograph records taken when making two welds, in which the current was allowed to flow after the arc was short-circuited. Fig. 3 refers to a weld made between ⅛in. tool steel and 1in. mild steel, the former being connected to the positive pole and the latter to the negative pole of the source of electrical energy. The time setting of the mechanism was 0.4 second, and air under a pressure of 60 lb. was supplied through an orifice $^3/_{64}$in. in diameter. It will be observed that the current during the arc period rose to somewhere between 1400 and 1500 ampères as a maximum, and that after the arc was short circuited a maximum of about 2400 ampères was reached. The length of time occupied by the whole process of forming a weld may be gauged from the horizontal row of dots in the centre of the diagram, the distance between each dot representing approximately one-twentieth of a second. Fig. 4 shows the welding of ⅛in. copper to ⅛in. copper. The time-setting of the instrument was in this case 0.25 second. It will be seen that immediately after striking the arc the current rose to about 1700 ampères, then fell till it was about 1400 ampères immediately before the arc was short circuited, after which the maximum attained was just over 3000 ampères. In this case the length of time occupied by the various operations was only just over one second in all. In each case there is a rapid rise in the value of the current when the weld is started by the closing of the main contactor. The value of the current reaches a peak and then begins to fall, as the result of the arc-striking solenoid drawing the blank apart from the shank—the arc voltage commencing to rise at the same time. The arc voltage continues to rise and the welding current is maintained to a greater or lesser extent in accordance with the characteristics of the weld, during the period in which the parts are held asunder, and which is relatively short as compared with the whole time period covered by each record. At the end of this period, however, the air valve is automatically operated, thus admitting air to the cylinder and bringing together again the parts to be welded. This action is shown on the records in each case by a rapid fall in the arc voltage and a corresponding rise in the welding current. The arc voltage drops to nearly zero, but the increased current is maintained owing to the short-circuiting of the arc, until the main contactor is finally opened, with the result that the current also dies away to zero.

It should be explained that both these records were obtained when using a motor generator in conjunction with a battery, a regulating resistance being used to limit the welding and short-circuiting currents. The supply voltage was 60 and an independent supply at the same voltage was used for operating the controls of the apparatus. For dealing with welds of steel rods up to 1¼in. in diameter a generator of special construction has been devised to the general specification of Messrs. Steele and Martin, and constructed by Messrs. Horace Green and Co., of Cononley. It is illustrated in Figs. 5 and 6, while its electrical connections are shown in Fig. 7. The specification on which designs of generators were invited set out that the following sequence of operations had to be provided for:—

(1) The main welding circuit is closed by an automatically operated contactor with the two parts to be welded together—the electrodes—in contact with one another.

(2) The arc is instantly and automatically struck and maintained between the electrodes on the closing of the main welding circuit contactor.

(3) After the arc has been maintained for a predetermined period, the molten faces or ends of the electrodes are forced into contact by automatic means, thereby short-circuiting the arc.

(4) After a very short period—less than 1.0 second—following the operation mentioned in (3), the main welding circuit is broken by means of the automatically operated contactor mentioned in (1), the weld being then complete.

Having regard to the heavy current to be anticipated when the arc is short-circuited, the consideration of those tendering was drawn to the possibility of de-magnetising the field of the generator, at the moment of short-circuiting, either by means of the apparatus controlling the welding process or in some other manner. It was further stated that the average voltage of a Cyc-arc weld might be taken as being 20, but that the arc voltage might go up to 35, and that the maximum current might be expected to be about 4000 ampères.

The special generator which was eventually built by Messrs. Horace Green and Co. consists of an open-type compound-wound dynamo with a separately excited shunt field, heavy compounding series winding, and interpoles. Tappings from the series winding are brought out to a terminal board together with the main welding terminals to facilitate adjustments for various sizes of welds, and there is an automatic contactor to short-circuit the series winding upon the completion of the weld. The generator is driven by a 10-kilowatt 350-volt three-phase squirrel-cage alternating-current motor mounted on the same shaft, while on a still further extension of the shaft there is a small 60-volt direct-current shunt-wound dynamo for supplying current to the field of the main generator and the control circuits. At the generator end there is a fly-wheel 44in. in diameter and having a face 4¼in. wide.

In commenting upon the operation of this self-contained set, Messrs. Steele and Martin inform us

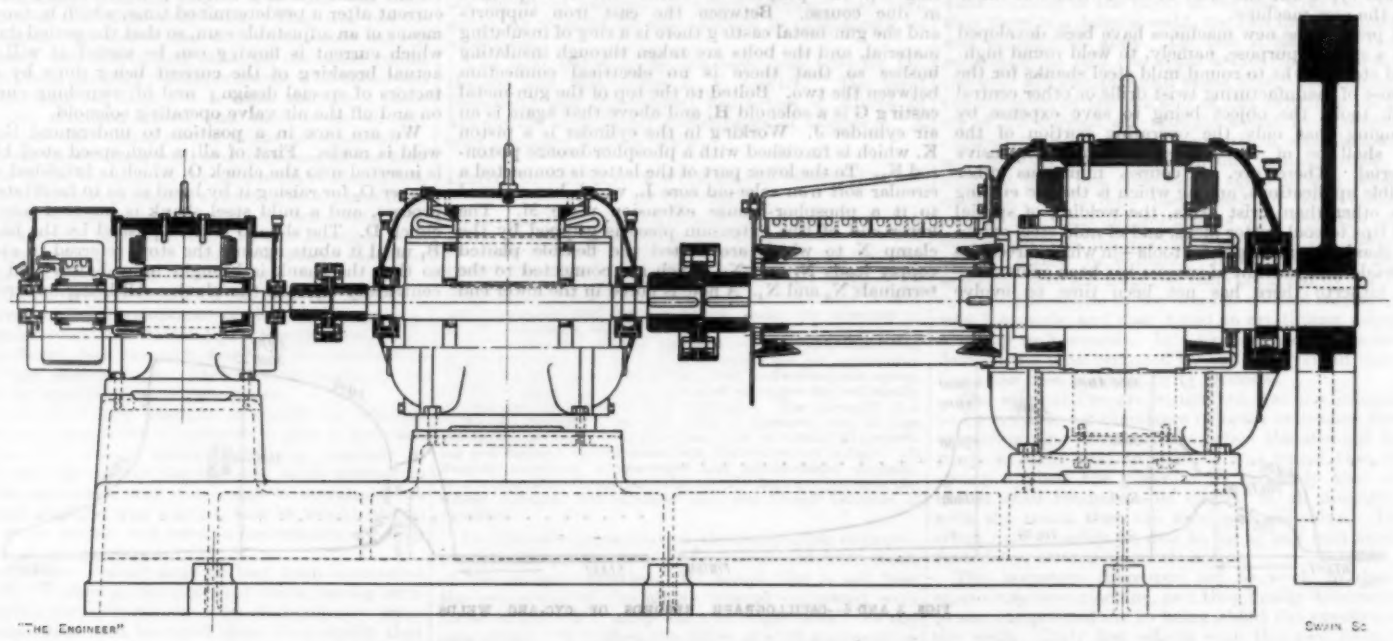
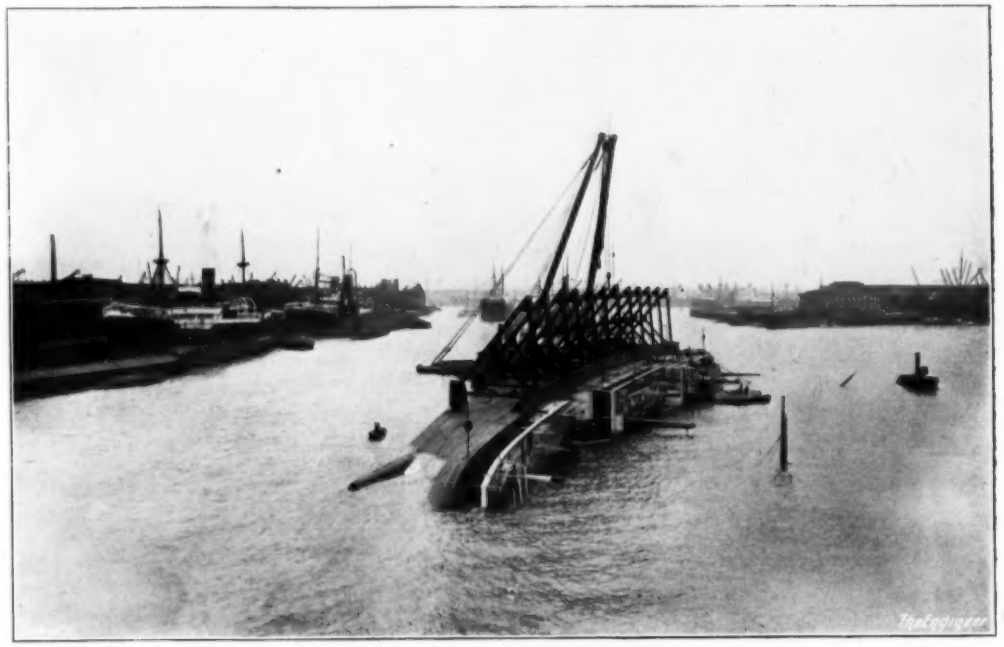


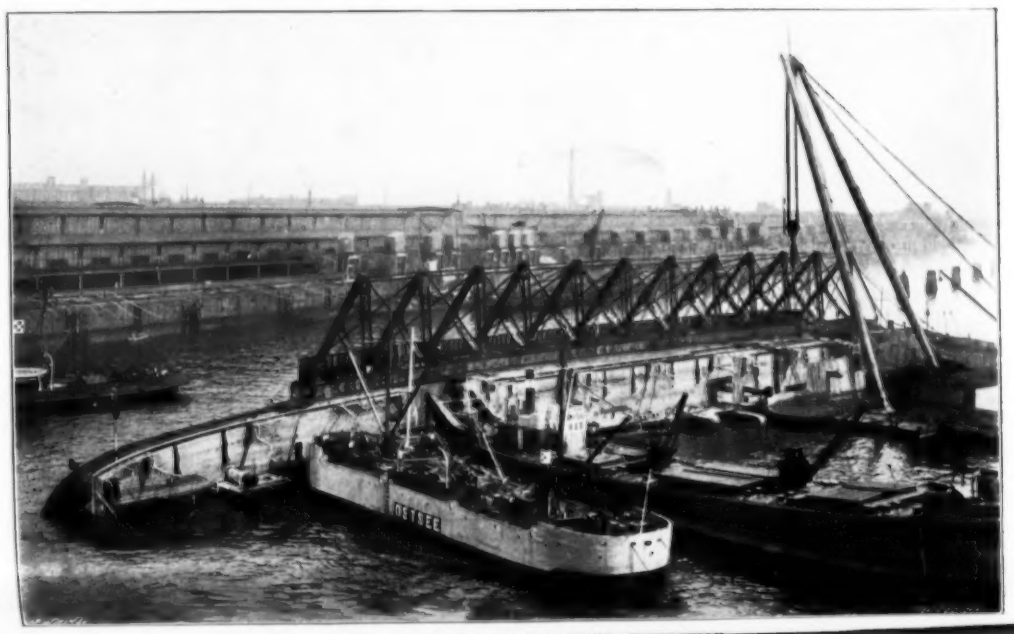
FIG. 6—LONGITUDINAL SECTION THROUGH MOTOR GENERATOR FOR CYC-ARC WELDING

SALVING THE BRAZILIAN LLOYD SHIP AVARE IN HAMBURG HARBOUR

AVARE SHORTLY AFTER CAPSIZING

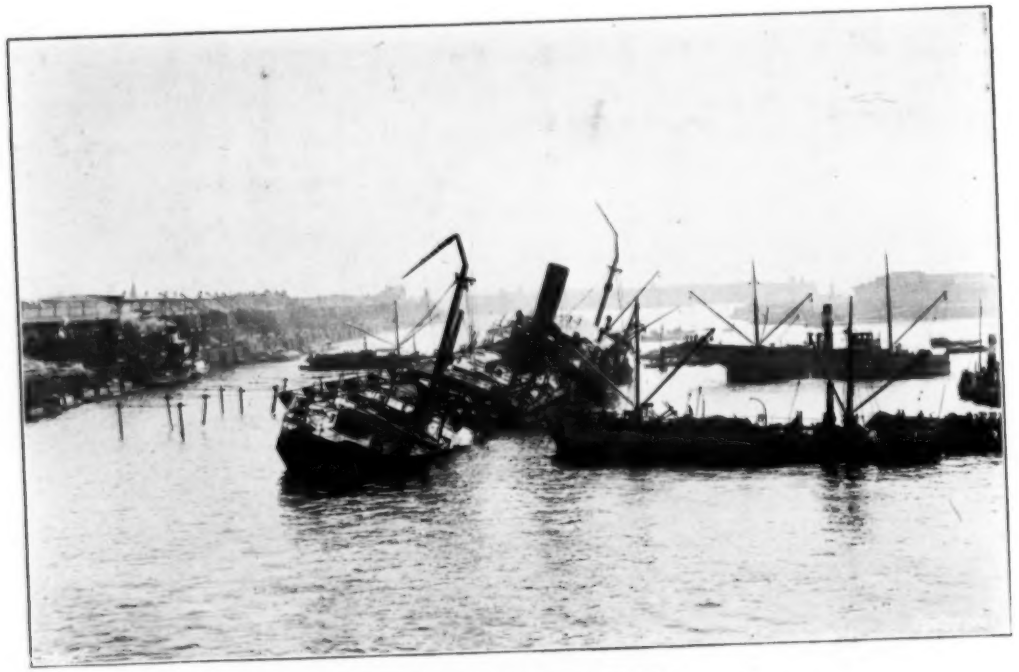


POSITION OF SHIP IN THE HARBOUR



PREPARATIONS FOR RIGHTING COMPLETED

FIRST STAGE OF RIGHTING OPERATION



SHIP RIGHTED THROUGH 45 DEGREES

AVARE IN DOCK AFTER SALVING

that after certain modifications had been made the set was found to give very satisfactory results with a separate excitation producing an open circuit generator voltage of about 30, and with the full additional compounding effect of the series field coils in operation. In these conditions efficient welds of steel bars up to 1¼in. in diameter can be obtained with arc-timing periods of about one second. The inductance of the series field coils, combined with the automatic short-circuiting—by means of a second heavy-current contactor—of the series field coils, at the moment of short-circuiting the arc to complete the weld, enabled the main welding

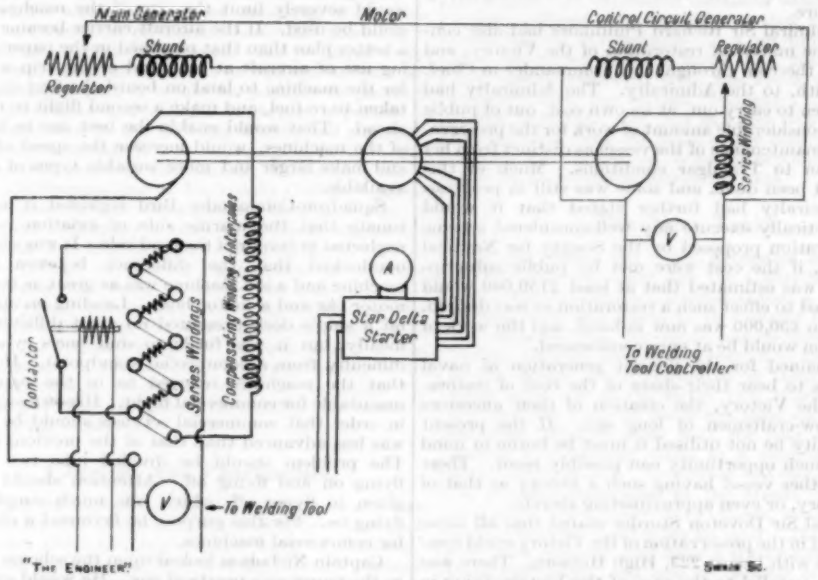


FIG. 7—DIAGRAM OF CONNECTIONS OF MOTOR GENERATOR FOR CYC-ARC WELDING

circuit contactor to deal satisfactorily with both the making and breaking of the main circuit, and also reduced the, previously rather heavy, sparking of the generator at the moment of short-circuiting, to a very considerable extent. As, however, the generator supply-current was found on test to rise to approximately 5000 ampères within half a second of striking the arc, that current being actually in excess of that specified and required for the largest steel bar weld which the plant is required to make, the generator sparking has been reduced to a negligible amount by introducing permanently into the main welding circuit additional inductance, and also a stablising

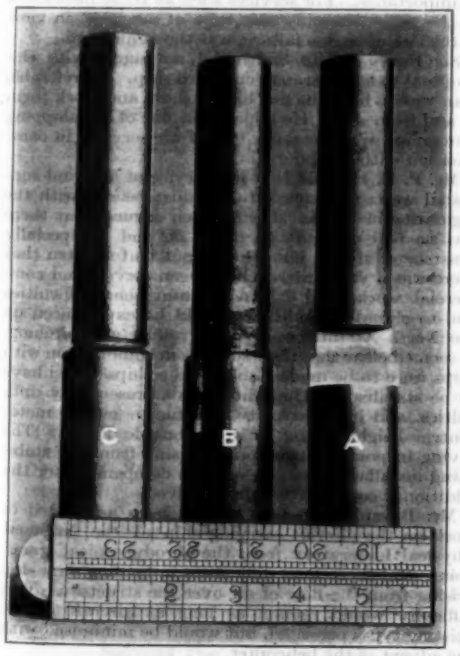


FIG. 8—EXAMPLES OF CYC-ARC WELDS

resistance, which latter is, however, only of a very low value—0.0025 ohm—when making welds involving a maximum momentary output of approximately 4000 amperes. The approximate voltage characteristics of the generator when operating under these conditions are:—Open circuit voltage, 30; maximum voltage with the arc maintained, 60; voltage upon completion of the weld and before breaking the main welding circuit, 20.

In addition, as the best method of regulation for the supply for smaller welds involving less current appears to be by increasing the stabilising resistance —as has, as a matter of fact, been done hitherto in smaller Cyc-arc welding of all kinds—a special regulating resistance has been designed. It consists of ten Nichrome elements, which, when all grouped in parallel, give the low resistance of 0.0025 ohm, and is capable of dealing with the maximum welding current. By disconnecting and re-groupir g the elements, welding currents of as low as 200 ampères may be obtained from the same supply plant. This smaller current, it may be explained, is quite sufficient for welding, say, ¾in. diameter steel drills.

No difficulty has been found either in connection with starting the motor generator set or with its recovery to full speed after each weld, notwithstanding the fact that the driving motor is a 220-volt three-phase machine. The small 60-volt direct-current generator, which supplies current for exciting the main generator and also for the Cyc-arc control circuits has proved to be quite satisfactory.

We may here say that we understand that, when running the motor generator set light between welds, the motor load is about 6 kilowatts, and that the additional energy absorbed when making the largest size of weld within the capacity of the set is only about 100 watt-hours. The maximum amount of energy taken hourly from the supply mains, when making the maximum welds at the rate of one per minute, would be, therefore, approximately 12 kilowatt hours. Hence, assuming a power cost of 1d. per unit, the maximum cost of the energy consumed in the machines we have described would be about 1s. per hour, which is almost negligible when com-

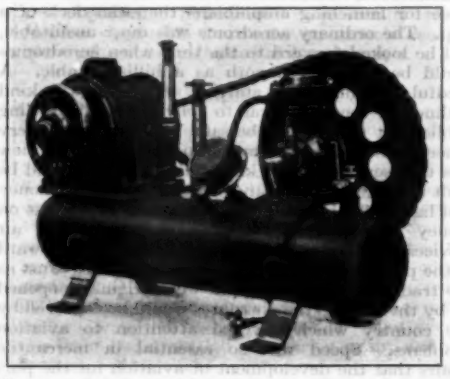


FIG. 9—PORTABLE AIR COMPRESSOR

pared with the value of the work which can be effected in the time.

As examples of the welds which are now being made by the larger of the two newer types of Cyc-arc welding machines—that is to say, those with air cylinders 6in. in diameter—we may draw attention to Fig. 8. The right-hand view lettered A represents a piece of 1¼in. diameter high-speed steel bar welded to a piece of ordinary 1¼in. diameter mild steel shafting, the weld being sectioned. The centre view—B—shows the same weld but photographed from the opposite side, while the left-hand view—C—represents a similar weld with a somewhat shorter timing. The weld in the case of A and B was made with an arc-timing period of 0.45 second, the maximum current being approximately 5000 ampères. It is pointed out that this weld was made primarily to test the capacity of the generator, without attempting to obtain the best settings of air pressure and orifice size to close up the weld perfectly upon completion. The air pressure used with this weld was actually below 50 lb., and from experience already gained with the combined new plant, it is not thought likely that pressures exceeding 100 lb. per square inch will be used in the welding of steel, and even that pressure would involve the use of a very small orifice leading from the air supply pipe to the air cylinder. The arc period used for the weld shown in C was 0.4 of a second, and the two views B and C show wonderfully clearly the different effect produced by even such a small decrease of the arc period as 0.05 second, owing to the heavy current supply which is increasing rapidly in value because of the characteristics of the supply generator.

Before closing this article we would draw attention to the neat little air compressor set shown in Fig. 8, which has been built to the specifications of Messrs. Steele and Martin and to meet the requirements of the new Cyc-arc welding machines by Lacy-Hulbert and Co., Limited. The compressor has a capacity of 0.5 cubic feet of free air per minute at a pressure of 100 lb. per square inch. The receiver has a capacity of ¼ cubic foot. The motor, which is shunt-wound for a voltage of 60 direct current, is of the variable-speed type. There are two relief valves on the receiver, one of which can be adjusted for pressures between 10 lb. and 60 lb. per square inch, and the other for pressures between 50 lb. and 150 lb. per square inch.

Institution of Naval Architects.

No. I.

THE annual meeting of the Institution of Naval Architects opened in the hall of the Royal United Service Institution on March 21st, and terminates to-day. There was a large attendance when the Duke of Northumberland, the President, took the chair.

REPORT OF THE COUNCIL.

In the annual report for the past year the Council reports that there has been an increase in all classes of membership, the total, after allowing for deaths and resignations, being 148 above the number on the roll in 1921. A statement of the receipts and expenditure during the past year shows a satisfactory financial position. The amount collected during 1922 for the prosecution of research work at the William Froude Experiment Tank was £1220, which is being transferred to the "Imperial Trust," for the special expenses of the research work that is being carried on, some results of which have been published in the "Transactions" of the Institution. The Department of Scientific and Industrial Research is prepared to contribute pound for pound to sums raised for this purpose. The honorary membership of the Institution has been conferred upon Monsieur Raiberti, French Minister of Marine, and gold medals of the Institution have been presented to Monsieur Bertin, President of the Association Technique Maritime, Monsieur Patry, general secretary of the Reception Committee in Paris, and Monsieur A. Normand, who organised the reception and visits at Havre. The Council has elected as honorary Vice-president Sir Archibald Denny, Bart., after thirty years valuable service on the Council. An important step has been taken jointly with the Institutions of Civil Engineers, of Mechanical Engineers, and Electrical Engineers, in the formation of a Joint Engineering Council upon which this Institution is represented by Sir John Biles and Sir Archibald Denny. The Joint Council is to consider matters referred to it by the Council of any one of the constituent Institutions, but shall not initiate proposals affecting the Institutions. This Committee, to which reference was made in the last annual report, has now been duly constituted, and is engaged in preparing for the trials which are shortly to take place. Messrs. Richardson, Westgarth and Co. have followed up their offer of placing a Diesel-engined ship at the disposal of the above Committee by making a contribution of £1000 towards the expenses that will be incurred in carrying out the proposed trials. Other Diesel-engined ships have also been offered to the Committee for trials. A scholarship in marine engineering of the value of £150 per annum for three years has been offered by Messrs. Richardson, Westgarth and Co. for the years 1923–24–25, and will be competed for on the same lines as the R. L. Scott Scholarship which it replaces. The gold medal and two premiums for the past year have been awarded as follows:—Gold medal, Mr. J. L. Kent, for his paper, "Experiments on Mercantile Ship Models in Waves"; premium, Mr. E. Leslie Champness, M.B.E., M.Sc., for his paper, "Longitudinal Strength of Cargo Vessels and its Variation with Fulness of Form"; premium, Major L. Fea, R.I.N., for his paper, "Some of the Consequences of the Washington Conference with Regard to Naval Construction."

In a short address the President referred to the satisfactory progress of the Institution both as regarded membership and finance. Unfortunately, he continued, it was impossible to say that the shipbuilding industry showed any material improvement, although signs of improvement were perceptible, and it was possible to look forward to a gradual revival. Many factors pointed in that direction. Progress was being made in the reduction of national expenditure, and in the relief of taxation. Serious as was the state of unemployment, the number of men out of work was gradually decreasing. This decline in unemployment was striking testimony to that class of the community which had had to bear the chief burden of trade depression. Another cause for encouragement was the recent absence of those labour troubles which had been so serious after the war. He hoped that the policy of the Government in connection with Whitley Councils and insurance for unemployment by industry would achieve success. The prosperity of British trade was largely dependent on the political situation, and especially on the European position, and at the moment the latter was precarious and fraught with anxiety. There was, however, ground for hope that a general settlement would be reached on the Reparations problem and on the even more important question of the security of France. The prosperity of Europe rested on an agreement between Great Britain, France and America. It was to be hoped, therefore, that the unanimity reached at the Washing-

ton Conference on affairs in the Far East would be repeated in the case of the tangled affairs of the Western hemisphere. That was the best hope for the future peace of the world and the security of civilisation. Referring to the report of the Council, he expressed the hope that further support would be given to the work of the Froude Experimental Tank. Shipbuilders had come forward, but he would like to suggest that the shipowner stood to benefit by the work which was being done, and it was worthy of his further support.

H.M.S. VICTORY.

The Secretary read a contribution from Sir Philip Watts dealing with the preservation of H.M.S. Victory and her restoration to the Trafalgar condition.

Sir Philip said that on his return to the Admiralty in 1902, he discovered the original sheer and profile drawing of the vessel. It had become much dilapidated, but he was able to have it fairly well restored and exhibited at a meeting of the Institution in 1905. He then stated that the Victory was launched in 1765, and, in spite of long years of arduous active service, was at that date the flagship of the Commander-in-Chief at Portsmouth, and was in good repair, a large quantity of timber damaged in action and decayed having been removed from time to time. Much of the old vessel still, however, remained.

Nearly twenty years had elapsed since he made that statement. Meanwhile, the effects of time had weighed very heavily on the Victory. It was no longer true that she was "in good repair." During the intervening years decay had set in so rapidly and so extensively that in order to avoid the risk of her foundering at her moorings she was taken into dockyard hands, had most of her ballast removed, and was, in January, 1922, placed in No. 2 dry dock at Portsmouth, where she now lay and would remain as long as skill and loving care could keep her intact. She was supported partly on her keel and partly on strong steel bilge crutches. She was shored as usual from the sides of the dock, and for the time being was entirely free from danger of collapse. She was still the flagship of the Commander-in-Chief at Portsmouth, and it was still true that much of the material of the old vessel remains.

An earnest appeal, largely based on the eminence of those officers who, long ago, carried their flags on her and the great deeds wrought by her in battle, was being made for the preservation and restoration of the vessel.

The interest to the naval architects was that a vessel launched in 1765, having fought for many years in line of battle, continuing on active service for ten years thereafter, kept in commission ever since, was in good repair in 1905 and was still strong enough in 1922 to bear the strains incidental to docking. This longevity was not only extraordinary, but was, he thought, without parallel. Cases of the great longevity of some wood vessels were on record. The Sovereign of the Seas, built at Woolwich in 1635, was one, and the Endeavour, Captain Cook's ship in his first voyage to the South Seas, was also reputed to have had an extraordinarily long life. The conditions which made for longevity in wood ships were never thoroughly understood, and scientific investigations were being made in the middle of the last century, but before a satisfactory conclusion was reached, the necessity for such investigations entirely disappeared owing to the advent of iron and steel as materials for ship construction. As an instance of the want of real knowledge of the conditions necessary for longevity, he would mention that in the winter of 1868–69 there was broken up in No. 4 dry dock at Portsmouth the two-deck wooden line-of-battle ship Superb. In the adjacent dock, No. 3, was the wood-built steam frigate Glasgow, which had not previously been outside Portsmouth Harbour except to make, in the early part of 1862, a steam trial, in an unmasted condition, in Stokes Bay. In 1863–69, many of the timbers of the Glasgow were so decayed that they were removed and replaced by perfectly sound wood taken from the Superb. In spite of the want of knowledge of the conditions necessary to secure longevity, these conditions conspired to preserve the Victory for us to this day, and in a condition making it practicable to preserve her for many years to come and to leave undisturbed a considerable portion of the existing material in her. As a piece of practical wood shipbuilding, he hoped that some day some one would trace out what might be called the life history of the structure of the Victory, dealing with all matters bearing on her repair from time to time and her exceptionally long life.

Any scheme for the preservation and restoration of the Victory must necessarily be founded on a knowledge of her condition at present. Such a scheme also obviously involved a close consideration of the amount of money available for the purpose. He had been appointed by the Society for Nautical Research to act as chairman of a sub-committee to consider what steps should be taken to preserve the ship and to restore her approximately to her condition at the Battle of Trafalgar. In this capacity he had made a survey of her and had forwarded an interim report relating thereto to Admiral of the Fleet Sir Doveton Sturdee, the President of the Society for Nautical Research, the body interesting itself in obtaining funds for the preservation and restoration of the Victory.

It stated that had she not been dry-docked she would have been in danger of sinking at her moorings. It was evident, however, that the structure of the vessel (in spite of the decayed condition of her timbers and much of her planking), with a properly devised and executed scheme of repair and restoration, could be brought into a condition in which it would be able, for many years to come, to bear all the strains that would be brought upon it in the vessel's present snug berth in dock. The chief features to be considered in the restoration were the masts, yards, rigging and the finish of the bow, stern and topsides. These, with the renewal where necessary of the defective timbers and the addition of the necessary fittings to bring the vessel to her Trafalgar condition, would entail heavy expenditure.

Vice-Admiral Sir Richard Phillimore had also considered the matter of restoration of the Victory, and reported thereon through the Commander-in-Chief, Portsmouth, to the Admiralty. The Admiralty had undertaken to carry out, at its own cost, out of public funds, a considerable amount of work for the preservation and maintenance of the vessel as distinct from her restoration to Trafalgar conditions. Much of this work had been done, and some was still in progress. The Admiralty had further stated that it would sympathetically execute any well-considered scheme for restoration proposed by the Society for Nautical Research, if the cost were met by public subscription. It was estimated that at least £150,000 would be required to effect such a restoration as was desired. More than £50,000 was now in hand, and the work of restoration would be at once commenced.

It remained for the present generation of naval architects to bear their share of the cost of restoration of the Victory, the creation of their ancestors and fellow-craftsmen of long ago. If the present opportunity be not utilised it must be borne in mind that no such opportunity can possibly recur. There was no other vessel having such a history as that of the Victory, or even approximating thereto.

Admiral Sir Doveton Sturdee stated that all those interested in the preservation of the Victory could communicate with him at 223, High Holborn. There was a curious parallel to the case of the Victory being in dock. Another ship, the Golden Hind, an Elizabethan warship, was put into dock at Deptford and cemented up, and when she was examined after a lapse of time, she was found to be so badly damaged that she had to be broken up. That famous warship was lost merely because no trouble was taken to save her. He trusted that the British people would save the Victory.

The Duke of Northumberland was re-elected President, and the ballot for other officers resulted as follows:—Vice-presidents, Sir Westcott Abell, Mr. W. J. Luke and Lord Weir; members of Council, Mr. R. R. Bevis, Mr. James Brown, Mr. P. T. Caird, Engineer-Vice-Admiral R. B. Dixon, Mr. A. E. Doxford, Mr. P. D. Ewing, Professor P. A. Hillhouse, Mr. L. Peskett, Sir Archibald Ross, Mr. F. J. Stephen, Sir George Thurston, and Engineer-Commander C. J. Hawkes; associate members of Council, Sir J. Alfred Ewing, Mr. W. E. Hichens, and Lord Invernairn.

Sir Eustace d'Eyncourt presented the paper by himself and Mr. J. H. Narbeth, "A Proposed Aircraft-carrying Mail Steamer," which appears on page 323.

Admiral Sir Mark Kerr said that there was no better place for launching amphibians than the deck of a ship. The ordinary aerodrome was most unsuitable, and he looked forward to the time when aerodromes would be made as smooth as a billiard table. A needful preliminary to starting services of the kind outlined in the paper was to convince the travelling public that they would be safe. Contrary to a very general belief air travel was not unsafe. His own view was that services of the kind contemplated should be built up in the first instance on the carriage of money and light valuable freight. The saving in interest on money in course of transmission by utilising air services would be considerable. The ideas put forward in the paper would be realised in due course. Just as the trade routes of the world were originally opened up by the ship, so the air routes would be captured by the country which devoted attention to aviation problems. Speed was so essential in mercantile affairs that the development of aviation for the purposes of commerce was inevitable.

Wing-Commander Robinson was much impressed with the close relation between matters nautical and aeronautical both in design and application. The authors had put forward a most interesting and far-seeing proposition which he hoped would be developed.

Engineer-Commander Onyon, referring to the somewhat startling proposal to carry the funnels horizontally, said that that plan had been the subject of controversy, and Messrs. Yarrow's experts had been called in to see if their smoke-damping arrangement could be fitted to the funnels to prevent the smoke from rising and thus interfering with the movement of the machines on and off the ship. Howden fans were employed in the early type of aeroplane carrier to get rid of the gases from the boilers. The specification was for a fan 117in. in diameter with a capacity of 184,000 cubic feet, and provision was made for a temperature of 500 deg. Fah. and a speed of 320 revolutions per minute. In actual tests it was found that only 162,000 cubic feet were required, that the temperature was 463 deg. Fah., and that the speed was 214 revolutions per minute. The Admiralty had, he remarked, asked fan designers to be prepared to deal with a power of 90,000 horse-power, which was not so simple a problem as it looked. He hoped that one of the shipowning companies would be prepared to build an aircraft-carrying vessel.

Wing-Commander Cave-Brown-Cave welcomed the proposal to use a carrier ship for commercial purposes with the object of increasing the speed of sea transport. The only difficulty was that it would be necessary, in receiving or launching aircraft, for the ship to turn head to wind, and that might in practice prove a serious disadvantage. It was obvious, too, that the type of machine selected was not the most suitable for the purpose. He did not agree with the plan of storing the aircraft in hangars on board ship, for it would severely limit the size of the machine which could be used. If the aircraft carrier became general a better plan than that proposed in the paper of making use of aircraft at each end of the trip would be for the machine to land on board the first ship overtaken to re-fuel, and make a second flight to the liner ahead. That would enable the best use to be made of the machines, would increase the speed of travel, and make larger and more suitable types of aircraft available.

Squadron-Commander Bird regarded it as unfortunate that the marine side of aviation had been neglected in favour of the land side. It was sometimes overlooked that the difference between a land machine and a sea machine was as great as between a motor car and a motor boat. Landing on and flying off a ship's deck presented no great difficulty technically, but it was futile to shut one's eyes to the difficulty from a commercial standpoint. He agreed that the machines referred to in the paper were unsuitable for commercial flight. His own suggestion, in order that commercial services should be started, was less advanced than that of the previous speaker. The problem should be divided into two parts—flying on and flying off. Attention should first be given to flying off, which was much simpler than flying on. For this purpose he favoured a clear deck for commercial machines.

Captain Nicholson looked upon the scheme outlined in the paper as a practical one. He would emphasise the fact, however, that the design and construction of flying boats and seaplanes was a very highly specialised branch of shipbuilding. He believed that within a few years the whole of the postal services across the North Sea would be run by flying boats. Steamship companies were the right people to handle the new form of transport, as they possessed the necessary experience. Some old-type flying boats had carried out commercial trials, and had proved to be suitable for commercial work. An example of this was the test made with one of the "F" type boats, which flew from Felixstowe round Scandinavia, covering 2450 sea miles in 40 hours 40 min. The boat was away twenty-seven days without a single mishap. The large flying boat had great possibilities for coastal and river traffic, and its higher degree of safety and independence of aerodromes were factors of importance. For services such as those mentioned in the paper the only safe type of machine, in view of the risk of engine failure, was the amphibian.

Sir Henry White Smith did not agree with the proposal to stow aircraft on board ship. A preferable plan was to base the machines ashore and work them to and from ship. He hoped that one of the shipping companies would make a test of air services in combination with shipping.

Mr. P. R. Lee said that if a service of the kind suggested was to be successful it must be run with the regularity of trains. It had been argued that there was no real difficulty in flying on and off specially constructed decks, but it must not be forgotten that there was a vast difference between service and commercial work, and it was certain that difficulties due to climatic conditions would be experienced on the North Atlantic route from rolling and pitching. It seemed clear that if air services in combination with ships were to be made a success the ships would have to be stabilised. That should not present any difficulties, and it ought to be possible to get the metacentric height down to a reasonable figure. The saving in power consumption arising from the stabilising installation would go far to compensate for the additional cost and weight involved.

Mr. Bryant, who said he had been associated in work on the aircraft-carrying ship at the National Physical Laboratory from the aerodynamical standpoint, said there were difficulties in landing on a ship arising from the flow of air over the structure. This difficulty would remain as long as aircraft of the existing types persisted, but would be minimised with the advent of the helicopter.

Mr. Narbeth, in a brief reply to the discussion, said the authors realised that the machines referred to in the paper were unsuitable for commercial work, and they agreed that the amphibian was the type which should be employed. It was intended to incorporate in the paper the idea of operating the machines from shore bases in order that machines of a larger and more suitable type might be used.

The annual dinner was held at the Connaught Rooms on Wednesday evening, and appeared to be more largely attended than ever before. The principal speakers were Mr. Amery, Lord Beatty, and the French Ambassador.

A Seven-Day Journal.

The Institution of Chemical Engineers.

WITH the holding of its first corporate meeting the Institution of Chemical Engineers may now be regarded as definitely among the learned societies. At the opening meeting about forty members were present. Sir Arthur Duckham, the President, said that the formation of the Institution helped to materialise what he had been dreaming of for some time, a federation of learned societies interested in engineering and chemical work. The principal object of the new body, he held, was an educational one, and it was hoped that it would be possible to persuade the universities and colleges to devote a portion of their attention to the training of chemical engineers. In this connection it was encouraging to note that the establishment of the Ramsay Memorial Chair in Chemical Engineering at University College, London, would soon be an accomplished fact, and that at Liverpool University a chair of chemical engineering would, it was hoped, soon be founded. At the Imperial College of Science instruction in chemical engineering had been given for the past eleven or twelve years, but it was to be regretted that that institution had not yet made chemical engineering one of its primary subjects. It was intended that the standard of associateship and membership of the new association would be such as to make the Institution the recognised authority in chemical engineering education.

Chemists and Pharmacists.

WHILE on chemical subjects, we may record that the Institute of Chemistry, claiming to be "the representative chartered professional body of chemists," is raising again the old subject of the title of "chemist" as adopted by and applied to one who is really a pharmacist. The subject has been given prominence by the action of the Retail Pharmacists' Union in issuing under the heading "The Chemist," a manifesto repudiating the grounds for the public's latest scare, the alleged inaccuracy in the dispensing of prescriptions. The Institute claims—and none can deny the abstract justice of its contention—that the title "chemist" belongs solely to one practising chemistry, and should not be given to one following the ancient and important calling of pharmacist. Whether, however, as the Institute implies, the present terminology is responsible for any important amount of confusion we have some doubts. The medical profession is, of course, jealous of the title "doctor," although academically speaking medical practitioners in general are no more entitled to it than every police constable is entitled to the term "sergeant." It would, however, be hopeless to endeavour to persuade the public to discriminate in the use of the title "doctor," and we fear it will be equally useless to endeavour to secure a general correct use of the designations "chemist" and "pharmacist"—or, for that matter, of the term "engineer."

The Red Star Liner Belgenland.

ON Saturday last the Belgenland, a palatial passenger liner of 27,000 tons, left Belfast for Antwerp to enter, on April 5th, the regular service of the Red Star Line between that port and New York. The vessel was under construction during the war period, and owing to shortage of tonnage she was completed as a temporary cargo ship by Harland and Wolff in 1917, and under the name of the Belgic was attached to the White Star fleet. After four years of this service her builders have recently overhauled and rebuilt her as a modern Atlantic liner in accordance with the original plan. There is accommodation for over 2500 passengers. The ship is propelled by means of triple screws, each wing shaft being driven by a four-cylinder triple-expansion balanced engine, and the centre shaft by a low-pressure turbine of the reaction type. The boilers are oil fired. A feature of the ship is the large electrical installation, comprising four 300-kilowatt direct-driven generating sets, and one 75-kilowatt emergency set. The Belgenland is a three-funnelled ship, and her graceful lines and cruiser stern give her a striking and handsome appearance.

Salving the Egypt's Treasure.

WHEN the P. and O. liner Egypt, on her way to India, collided with the French cargo steamer Seine and sank off Ushant on May 20th last year, she carried with her to a depth estimated at the time to exceed 60 fathoms a consignment of gold and silver valued at £1,100,000. We are not aware whether it has since been discovered that the wreck is lying at a less prohibitive depth, but it is reported that an arrangement has been made by a well-known salvage company under which an effort is to be made this season to recover some or all of the treasure. The difficulties, it is admitted, are very great, but encouragement to undertake the work is being derived from the success which has attended the prosecution of the similar work on the White Star liner Laurentic, which was sunk by mine or torpedo in Lough Swilly in January, 1917. So far, it is stated, gold to the value of £1,600,000 out of a total consignment believed to amount to over £3,000,000 has been recovered from that vessel, but it should be noted that she lies at a considerably less depth than does the Egypt. In the case of the latter vessel the underwriters suffered very heavily, for they had to pay a total loss on the treasure on a premium stated to have amounted to little more than 20s. per £1000. Any wealth recovered from the wreck will be their property after the salvage company's expenses and profits have been met, but in order to avoid further loss accruing from the disaster the contract with the salvors, it is understood, is on the principle that there shall be no payment without results.

The New Tanks.

IN introducing the Army Estimates in the House of Commons the other day the Under-Secretary for War, Colonel Guinness, intimated that a new type of fighting tank was about to be brought into use. It now appears that for some considerable time past Vickers Limited have been prosecuting developments in the design and construction of these formidable weapons of war at the River Don Works, Sheffield, and that the progress made has been such as to lead the War Office to place with the firm an order for twenty new pattern tanks at a contract figure of about £6000 apiece. According to Colonel Guinness, the average endurance of the tracks of tanks as used in the war was about 150 miles, while the speed rarely exceeded eight miles an hour. The new tanks, it is to be inferred, will have a track endurance of at least 1000 miles, and will be capable of reaching a speed of 25 miles an hour without over-exertion. They will have a length of 35ft., and will be provided with an armoured turret. Special attention has been paid in their design to the reduction of rolling and pitching, and to their employment not only as tanks pure and simple, but as tractors for hauling heavy guns into position.

Electrical Power Engineers.

FOLLOWING a dispute at Halifax regarding a proposed reduction of salaries and involving the dismissal of certain of its members employed on the technical staffs of the Corporation power-houses in that city, the Electrical Power Engineers' Association has decided to take "national drastic action" unless its grievances are met within a stipulated time. It has also decided to lay the matter before the Ministry of Labour and to call upon that department to take immediate steps to restore the situation at Halifax and to institute an inquiry into the dispute under the Industrial Court Act of 1919. Although the technical staffs in power-houses have so far refrained from taking national drastic action in any previous dispute, the Association repudiates emphatically the employers' suggestion that under no circumstances have its members any right to take such action.

Empire Trade.

ON Thursday, the 15th, the National Federation of Iron and Steel Manufacturers gave a luncheon to Sir Philip Lloyd-Greame, President of the Board of Trade, at the Grand Hotel. Mr. J. Craig presided, and in proposing the toast of "The Prosperity of British Industry and Trade," alluded particularly to the present condition of the iron and steel trade, in which it was impossible to make prices commensurate with the costs of production. Towards the end of last year an improvement in the industry seemed to be taking place, but the recent events in the Ruhr had unsettled the market again, and whilst feverish orders might favour trade temporarily they never did it permanent good. In replying to the toast, Sir Philip pointed to the progress of the past few months, which showed an increase of 35 per cent. in pig iron and of 50 per cent. in steel, and expressed agreement with Mr. Craig's views as to the stabilising of prices with the exception of railway rates. Alluding to the work of the Federation itself, he dwelt upon the "advertising" advantage of a big spectacular contract, and suggested that the expenses of getting such a contract, if they were too great to be borne by one firm, should be taken by the Federation as a whole.

The Suggested Charing Cross Bridge.

WHILE no final decision has yet been come to regarding the proposed new bridge across the river Thames, for the site of which there is a strong body of opinion in favour of the neighbourhood of St. Paul's, attention is still being given to the Charing Cross site. The reasons for the selection of this point are twofold, one being utilitarian and the other artistic. The existing Westminster and Waterloo bridges are about 1200 yards apart, and the Charing Cross railway bridge is not far from half-way between them, and occupies a position at which an additional road traffic bridge is admittedly badly needed. From the other point of view the west end site provides far greater scope for the exercise of town planning than does the site in the City, and exercises an immense fascination upon those who love to let their fancy play with the rebuilding of London on lines "nearer to the heart's desire." An interesting exhibition of proposed designs for the bridge and its approaches has been opened by the London Society. The designs are the work of Sir Reginald Blomfield, Sir Hamo Thornycroft, Mr. Paul Waterhouse, and other well-known architects, and, in general, are ambitious in the extreme. Of the eighteen schemes, the majority involve the removal of Charing Cross railway station to the south side of the river. Some of them show a high-level bridge, utilising the existing station site for the approach, while others favour a low-level bridge connecting with the Embankment road after the manner of Westminster and Blackfriars bridges.

Another Large Motor Liner.

AN order has been placed by Mr. Dan Brostrom, of Gothenburg, with Armstrong, Whitworth and Co. for a 17,000-ton ocean-going twin-screw passenger vessel to be propelled by internal combustion engines of an interesting new type. The total horse-power to be developed—13,500—will be about the same as that to be provided for the Sulzer-Diesel-engined liner now under construction at Fairfield for the Union Steamship Company of New Zealand. That vessel, however, is to be propelled by means of four screws, whereas, as stated, the new Swedish ship is to have twin screws. Its engines will be constructed by Burmeister and Wain, of Copenhagen, and their chief novelty will be that the cylinders will be double-acting. At present the largest marine motor engines are single-acting, and develop about 750 horse-power per cylinder, but in the new engine the cylinder power will be about 1000, and will be secured, it is stated, without material increase in the overall dimensions.

The Inchinnan Bridge.

THE new rolling lift bridge spanning the river Cart at Inchinnan, near Renfrew, was officially opened for traffic on Wednesday afternoon. It was designed and built by Sir William Arrol and Co., Limited, and is a commodious and modern structure. It will without doubt be warmly welcomed throughout the West of Scotland, for the old Inchinnan swing bridge was notorious for the restrictions it imposed both on the road and river traffic. The width of the new carriageway is 20ft., as against the 14ft. of the earlier bridge, while the river waterway has been increased from 45ft. to 90ft. in width. The work has been carried out under a Provisional Order granted to the Corporation of Paisley, but we understand that the initial steps in promoting the scheme were taken by the Cart shipbuilders, who, along with the Ministry of Transport and the Burgh and County authorities of Renfrew, are sharing with the Corporation of Paisley the cost of the undertaking. The new bridge should mark the beginning of a happier phase in the history of the Cart as a shipbuilding river.

Sixty Years Ago.

IN our issue of March 20th, 1863, a prominent position was given to a paper read before the Society of Arts by Commander Bedford Pim, R.N., entitled "An International Transit Route through Nicaragua." Commander Pim, with "his dear friend the late Mr. Robert Stephenson," had studied the question of transit at the isthmus of Suez, and when subsequently he was ordered on service to Central America he naturally devoted close attention to the corresponding transit problem of the New World. He found the Panama railway in full working order. It had been begun in 1850, and was opened for traffic in January, 1855. It was constructed by the enterprise of three Americans, Messrs. Stephens, Aspinwall and Chauncy. In order that our Transatlantic brethren might not fulfil their object of monopolising the entire field, Commander Pim proposed to construct an alternative gateway to the Pacific through Nicaragua, or, more precisely, through Mosquito, a country over which we had then just abandoned our protectorate "under the intimidation of the United States," and which had been ceded to Nicaragua. The proposed railway would have had a total length of 225 miles as compared with the 47 miles of the Panama line. It remains unconstructed. The progress being made with the construction of the Suez Canal was reported on a subsequent page. About 20,000 natives were then at work on the excavations and the formation of the town of Port Said had been begun. Strong doubts, however, were expressed whether the canal would ever be completed on the scale originally assigned to it, and, if completed, whether it would be a commercial success.

Salving the Avaré.

ON JUNE 16th of last year an extraordinary accident took place in the harbour at Hamburg. As the Brazilian Lloyd steamer Avaré was being towed out of dock she suddenly capsized and foundered. The Avaré was formerly the Sierra Salvada of the North German Lloyd Line, and she is a vessel of some 8000 tons gross with a length of 437ft. and a breadth of 55ft. 9in. The accident was attributed to insufficient stability caused by the half-filled conditions of a number of the double bottom tanks.

The position of the ship as she lay in the harbour fairway will be seen from the photographs reproduced in the Supplement included with our present issue, and also from the drawings—Figs. 1 and 2—showing the arrangement of the salving equipment. The ship rested sideways on the hard sand of the harbour bottom, and at mean high water the hull was a little more than half submerged. Fortunately an adjacent harbour quay, about 650ft. distant, provided a suitable position for operations from the land side. It will be seen that in order to right the vessel she had to be turned through 90 deg.—Figs. 2 and 3—and the calculation of the righting moment was rendered complex by reason of open port-holes, and by compartments that were difficult to pump out.

In preparing the plan of work help was afforded by the recorded facts of a previous similar occurrence, namely, the capsizing of the Gneisenau in the mouth of the Scheldt. The salving of that vessel was carried out in an excellent manner by the firm of Dykerhoff and Widmann, and the complete technical information which was published concerning the operation assisted very considerably in speeding up the work on the Avaré and making sure progress possible. The righting operation was, as a fact, accomplished in a remarkably short time, and the moments and forces actually experienced approached, in all cases, very nearly to the calculated values.

PREPARING THE SHIP FOR RIGHTING.

A consideration of the problem showed that it would be necessary to provide an arm with considerable leverage if the ship was to be completely righted without changing the point of application of the pull during the operation. The weight of the ship was 6200 tons, and in order to reduce the righting moment as much as possible, it was proposed to utilise the effect of some 800 tons of water ballast in the double-bottom tanks, and at the same time to reduce the weight to be lifted by pumping out certain compartments which had previously been rendered approximately watertight. According to calculation a weight of 5100 tons remained to be dealt with, and the necessary righting moment was 35,600 ton-metres. By dredging a long trough in the harbour under the ship parallel with her bottom, it became possible to improve the conditions, for when she was moved into the trough the turning point of the whole system was raised. The various phases of the righting operation are illustrated in the lower half of Fig. 3. Assuming a total pull of 1440 tons and a leverage of 25 m., it was found that with the material to hand at the Vulcan yards, twelve triangular-shaped brackets would best meet the requirements. The general design of the brackets and their finished appearance will be seen from the illustrations reproduced in Figs. 3 and 6. These frames or brackets were fastened to the ship's plating in such a manner that the lower attachment, which after righting was submerged, could be released without unduly difficult diving work. For this reason bolts were used as far as possible. The beams on the lower compression side were only intercostal, whereas on the upper tension side—see Fig. 3—a continuous girder was employed. It is to be noted that the compression forces were transmitted to the hull of the ship at the turn of the bilge, advantage being taken of the strength of the tankside knees.

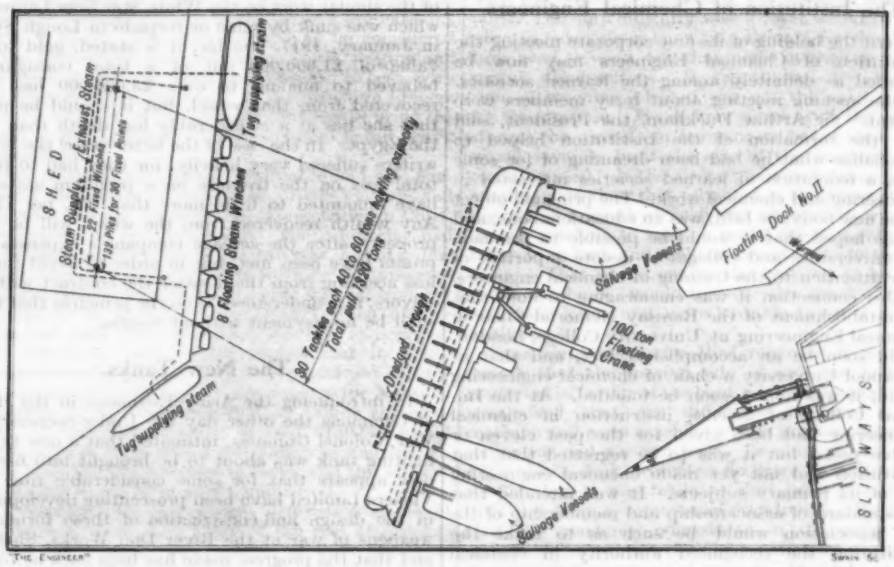


FIG. 1—GENERAL PLAN OF SALVING OPERATIONS

The tension members, on the other hand, were attached to the ship's plating at a point near the main deck, the strength of the ship at this part being increased by the deck stiffening.

The total weight of the twelve brackets, with the supporting girders and fastenings, was about 200 tons, and the complete erection of all the structural work was accomplished within twenty-one days. As shown by Fig. 6, the individual members were lifted into position by the 100-ton floating crane, which also played an important part in the final righting operations. Special strengthening for the crane hook attachment was provided at suitable positions between the boat and bridge decks. The floating crane lift was reckoned at 100 tons, and, in addition, the salvage vessels were placed fore and aft—see Fig. 1—the total lifting power of each pair of vessels being approximately 300 tons. The hauling tackles were so designed that the pull on each bracket did not exceed 40 to 60 tons. Calculation showed that at least thirty winches would be required, each having a capacity of 4 to 5 tons pull, varying according to the arrangement of the pulley blocks.

A fixed point for the tackles at the shore end was made by securing them to a series of piles which were driven in the centre of the shed floor—see Fig. 2. For each of the 40-ton tackles four piles were driven, while six piles were provided in the case of the 60-ton tackles. The piles were driven slightly obliquely to a depth of 30ft. to 33ft., and the upper ends were

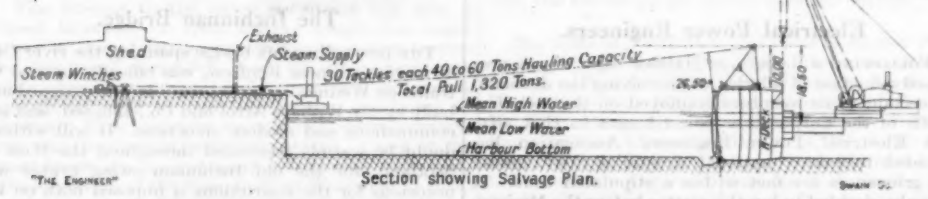


FIG. 2—ELEVATION SHOWING POSITIONS OF WINCHES AND CRANE

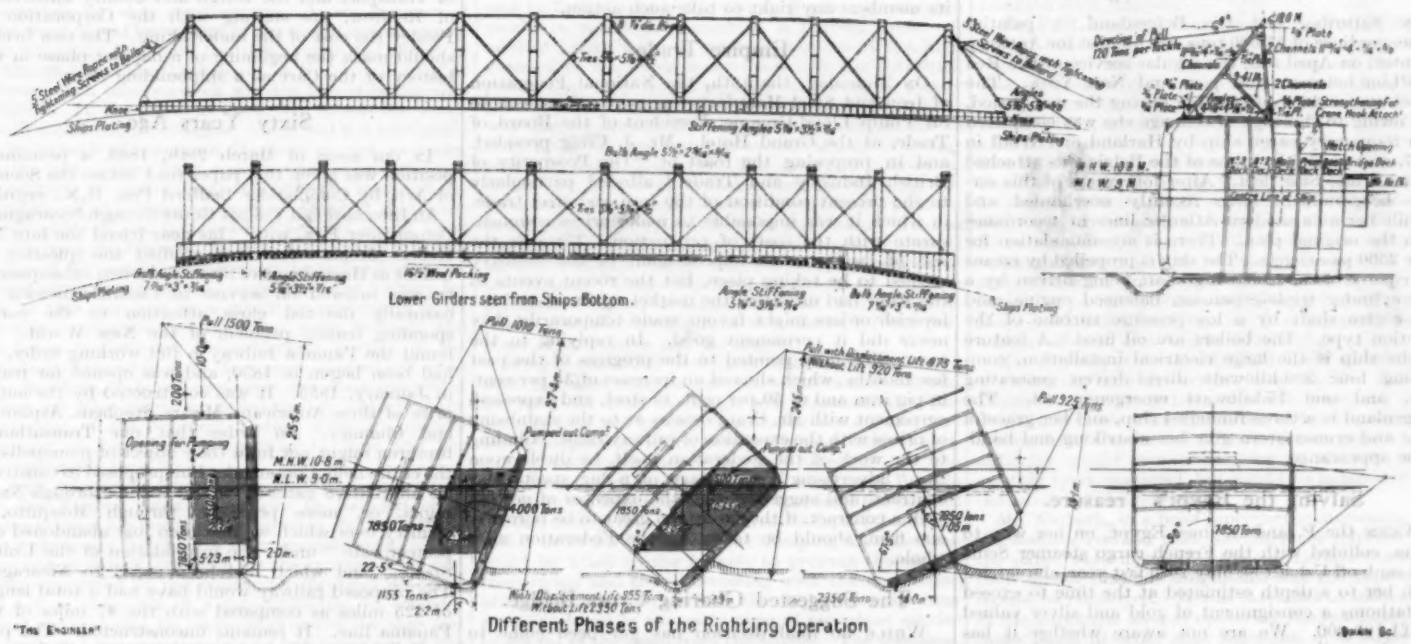


FIG. 3—ARRANGEMENT OF TRIANGULAR BRACKETS AND PHASES OF THE RIGHTING OPERATION

strengthened by iron clamping bands. Immediately behind the large piles two smaller piles were driven to a depth of from 16ft. to 20ft., and these served as a forward support for the three banks of timber forming the foundation for each winch. The arrangement of the piles and the winches will be seen from the illustration reproduced in Fig. 5.

The space available in the shed was not sufficient to accommodate thirty winches in line; twenty-two fixed winches were therefore used, and eight additional floating winches were requisitioned from various Hamburg firms and moored alongside the quay wall. Steam was supplied by two tugs anchored in the position shown in Fig. 1. The total boiler heating surface of these two vessels was about 5730 square feet, and steam was raised to a pressure of about 175 lb. per square inch. It is of interest to learn that all the work of preparation was carried out according to programme without hitch.

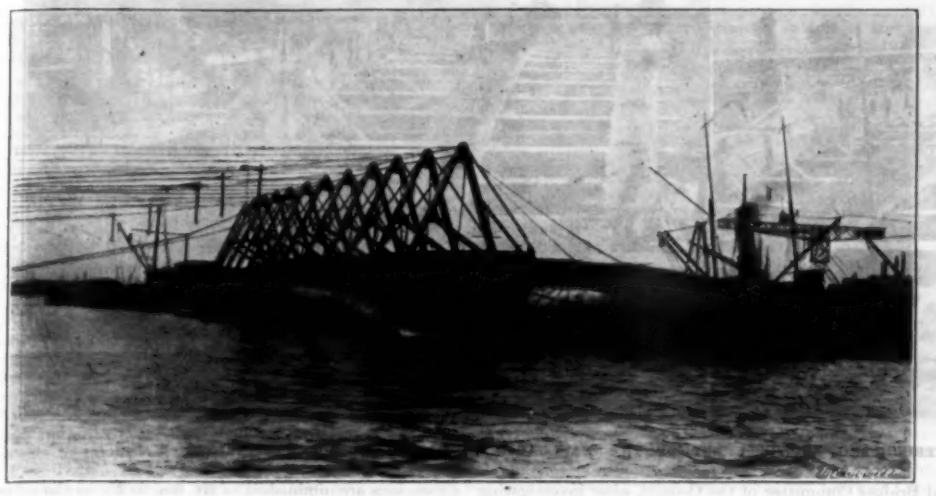


FIG. 4—THE AVARE READY FOR RIGHTING

An exception to this statement may perhaps be made in the case of the operations on the ship herself, which were concerned with the making of submerged compartments water-tight and pumping them out. As the righting operation proceeded it became evident that with the available pumping arrangements it was a very difficult matter to render the underwater compartments so water-tight that an appreciable difference of water level could be maintained.

FIG. 5—ARRANGEMENT OF FIXED WINCHES AND PILES IN SHED

CALCULATED FIGURES AND RESULTS.

Some account of the estimated moments to be overcome and the righting moments may be of interest to our readers. The figures given in the following tables were substantiated by the practical results, and it will be noted that a 10 per cent. reserve margin was allowed for in calculating the righting moments.

As the ship began to move from its first position it became clear that the suction between the ship and the harbour bottom was considerably in excess of that which had been assumed; further, the effect of the sludge and bilge water on the starboard side was greater than expected. Nevertheless, the salving operation was carried out without any delay or mishap, save the breaking of one or two wire ropes due to unavoidable inequality of load. These ropes were repaired and the work proceeded.

The actual righting of the ship, begun on the morning of Aug. 16th, almost exactly two months after the accident had taken place. Pumping was commenced and under the combined pull of the winches and the lifting of the crane and salvage vessels, the ship was turned through the first few degrees. A short pause was necessary to replace certain tackles and to repair a burst steam main, but twenty-four hours after starting the ship had been turned through 74 deg. Inspection then showed that the precautions taken had avoided any deformation in the shape of the hull. Continued pumping operations gave increasing indication of the floating of the ship, and as she was lying with a 16 deg. list, the question of her stability had to be taken into account. It was eventually decided to stabilise the ship by means of 3200 tons of sand ballast. Under these conditions she had then a metacentric height of 1.9 m., which was reduced by the free water in the fore and aft peaks, shaft tunnels, and engine and boiler-rooms to an MG. of 1.09 m. if the vessel was floated at high water, or 0.65 m. at low water. The actual floating took place midway between high and low water. When fully stabilised all cargo holds were pumped dry, and there were 800 tons of sand ballast in No. 4 hold aft, No. 3 hold aft was empty, while No. 2 hold forward contained 1000 tons of sand ballast, and No. 1 hold forward 1400 tons. When dry docked the vessel was shown to be fully stable.

The complete operation of righting the Avaré is one of unusual interest to salvage engineers, and we have to express our appreciation of the courtesy of Dr. E. Foerster, editor of *Werft-Reederei-Hafen*, and the Vulcan Company, Limited, which has enabled us to include in the present article some hitherto unpublished particulars and illustrations. The contract for the salving operations was divided between two firms. The Vulcan Works had charge of the supervision of the whole of the operations, and carried out the necessary structural work, while the Bugsier Slipway and Salvage Company, Limited, supplied the salvage vessels and appliances, and prepared and completed the installation of winches.

TABLE I.—*Moments to be Overcome.*

Description.	Weight in metric tons.	Centre in metres.	Moment in ton-metres.
Hull and machinery	6200	8.1	52,200
Iron ballast on board	100	2.0	200
Weight of brackets and tackle	200	7.5	1,500
Water ballast in double bottom	750	0.6	450
Sludge and bilge water in ship	600	7.5	4,500
Total weight in ship	7850	(7.23)	56,850
Less lift of pumped out compartments	3500	4.3	15,050
Weight by difference	4350	(9.6)	41,800
Suction (say, 20 per cent.)	870	8.00	6,960
Total moment with respect to the keel datum	5220	(9.34)	48,760
Total moment with respect to turning point	5220	(7.34)	38,320

FIG. 6—LIFTING THE BRACKETS INTO POSITION

TABLE II.—*Righting Moment Calculated with Respect to the Turning Point.*

Description.	Pull in metric tons.	Leverage in metres.	Moment in ton-metres.
Purchase tackles	1320	25.5	33,650
Lifting power of forward salvage vessels	300	14.0	4,200
Lifting power of aft salvage vessels	300	13.0	3,900
Lifting power of floating crane	100	14.0	1,400
Total righting moment	2020	(21.0)	43,150

New Bridge at Muskham on the Great North Road.

AT the end of last November there was formally opened for traffic a new bridge which has been built to carry the Great North Road over an arm of the river Trent, just north of Newark, and between that town and Retford. The bridge which it has displaced, and a view of which is given in Fig. 6, page 316, was of considerable interest, as it was a timber structure dating as far back as the year 1652, when it was built to take the place of a previously existing bridge which was destroyed during the Civil War. It is noteworthy, as a matter of history, that on September 3rd of the year mentioned the following order was made at a Sessions at Southwell:—

> BE IT REMEMBERED that William Willoughby of South Muskham, Esq., did this day in open Court promise and acknowledge himself that in his own right he would beare half the charge of the building of Muskham Bridge, which the country who are by consent to beare the other half in regard it was broken downe in time of Warre. And did also ingage himself that for the future he would at his own charge and in his own right from time to time duely Repayre the said Bridge without any further charge to the Countrey as being a charge which he acknowledgeth himself to be legally liable unto in respect of the tenure of severall his lands in Muskham aforesaid of the cleere yearly value of fifty pounds whereof he promiseth to deliver a particulor at the next general Sessions of the peace to be hold at Newark for the County of Nott to which the said Mr. Willoughby subscribed his name in the Wastbooke.
>
> (Signed) WILL. WILLOUGHBY.

This order was confirmed at the Quarter Sessions held on October 6th, 1652.

That the bridge must have been well built and maintained is evidenced by the fact that it continued in the form in which it was originally erected until it was pulled down last year. It is difficult to understand, however, why it was not replaced before, for it was incapable of

supporting traction engines or other heavy loads in spite of the fact that it formed part of one of the most important arterial roads in the kingdom. Furthermore, as will be seen in Fig. 3, which gives plans of the old and new bridges, there was a particularly bad curved approach on the south side, in order, evidently, that the bridge might cross the river at right angles. As evidence that it was incapable of carrying heavy traffic it may be mentioned that during the war, when risks were taken which in times of peace would not have been run, a heavily laden lorry was being driven over the bridge when the driver felt the roadway sinking below him. His efforts to extricate himself only made matters worse, and when an examination was made it was found that the fifth row of piles from the left in Fig. 6, page 316, had been forced downwards for quite a distance. Temporary repairs were effected by employing make-up pieces so as to restore the road surface to its original level, and the incident served to draw attention more forcibly than ever to the necessity for providing a bridge capable of supporting weights which are nowadays carried on motor vehicles, heavy traction engines, &c.

FIGS. 1 AND 2—VIEWS SHOWING CENTERING AND REINFORCEMENT OF THE MAIN ARCH RIBS OF NEW MUSKHAM BRIDGE

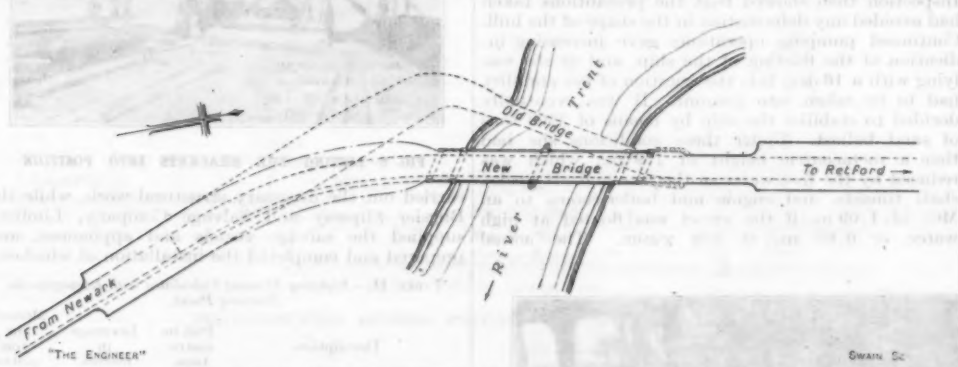


FIG. 3—PLAN SHOWING POSITION OF OLD AND NEW BRIDGES

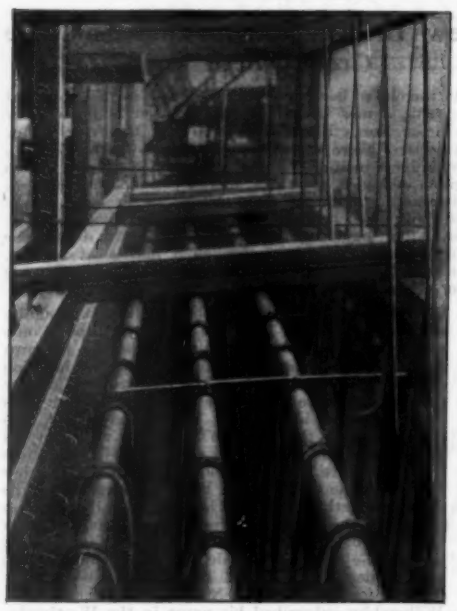


FIG. 4—REINFORCEMENT AT CROWN—INSIDE RIB

The question of replacing the old structure had, as a fact, been under consideration by the Nottinghamshire County Council for some twenty years and more, but it was not until 1920 that it instructed its engineer, Mr. J. Cracroft Haller, to prepare alternative schemes and estimates for the erection of a new bridge. The Highways and Bridges Committee of the Council, after investigating several schemes put before it, recommended the adoption of that for a reinforced concrete structure at an estimated cost of £50,000. Towards the cost, Lord Middleton, who, as direct descendant of the William Willoughby mentioned above, was responsible for the maintenance of the old timber bridge, made a contribution of £5000 and gave the necessary land for the improvement of the south approach to the new bridge on condition of being released from any further liability. The country—in this case represented by the Ministry of Transport—after approving the scheme, consented to pay half of the remaining £45,000, the other half being found by the Nottinghamshire County Council. As the result of inviting tenders a contract for the construction of the new bridge was entrusted to Walter Scott and Middleton, Limited.

As will be seen from the plan given in Fig. 3, it has been possible, by adopting a bridge of skew design, to obtain an absolutely straight approach from the north and considerably to improve the approach from the south. The new bridge, a view of which, in its complete stage, is given in Fig. 8, page 316, while views of it under construction appear in Figs. 1, 2, and 7, consists of two arch spans and two short girder flood openings, one at either end. The angle of skew is 68 deg. with the line of the river. The two main arches have each a span of 100ft., with a rise of approximately 9ft. 6in., and the flood openings have each a span of 25ft. The normal levels of the river are in summer 20ft. and in winter 22.5ft. above Ordnance Datum. The level of the springing of the arches is 30.5ft. above Ordnance Datum, and the highest known flood level, which was in 1875, was 36.4ft., or just less than 6ft. above the springing. The gradient given to the approaches is 1 in 100. The total width of the bridge between parapets is 40ft., there being a roadway 28ft. wide, and a 6ft. footpath on each side.

The foundations of the abutment and pier rest on Keuper marl 24ft. below the springing of the arches, and 13ft. 6in. below the normal summer level of the river. The pier in the centre of the river is of mass concrete having a foundation 12ft. wide and 65ft. long in the direction of the stream. The pier, which is 10ft. wide, is finished with a cutwater at each end. The abutments, which are also of mass concrete, comprise a foundation slab 5ft. thick over an area of 46ft. 6in., with a vertical wall in front 9ft. thick supported by four counterforts, two outside and two inside, the former being 4ft. and the latter 5ft. in thickness. At the back of the abutments four concrete piers are brought up from the concrete base to receive the ends of the reinforced concrete girders over the flood opening, the intervening space being filled up with earth to the floors of the flood opening, which are paved with stone pitching 8in. thick. Both the abutments and pier are formed of concrete mixed in the proportions of six parts gravel and sand to one part of cement.

The two main spans are each formed with four arch ribs of rectangular cross section. Above each rib and connected to it are spandrel columns, and a longitudinal main beam with secondary beams to carry the floor or decking, the whole being in monolithic construction. The two outer ribs measure 3ft. by 2ft. at the springing, which dimensions are diminished to 2ft. 6in. to 2ft. at the crown. The reinforcement—see Figs. 1, 2, 4, and 5—consists of sixteen 1¼in. diameter rods at the springing, diminishing to eight 1¼in. diameter rods at the crown. The two inside ribs are 3ft. by 3ft. at the springing, diminishing to 2ft. 6in. by 3ft. at the crown. They are reinforced by twenty-four 1¾in. diameter rods at the springing, that number being reduced to eight rods of the same diameter at the crown. In each case half the steel is in the top of the rib, and the other half at the bottom, the whole being tied together by means of $^{5}/_{16}$in. diameter rods. The arrangement of the steel reinforcement at the crown and at the springing of an inside arch rib are shown in Figs. 4 and 5 respectively, while Figs. 1 and 2 give general views of the centering and steel reinforcement for the main arch ribs. The main beams, secondary decking, and the parapets are, like the arch ribs, reinforced with round steel bars of various diameters, and the whole of the reinforcement was carried out on the Hennebique system of Mouchel and Partners, Limited. A view showing the centering employed during construction is given in Fig. 7, page 316. The bridge was designed to carry a moving load of 60 tons spread over four axles, it being considered that such provision would meet the requirements of any traffic passing over the bridge. As will be observed, the design of the bridge is plain, though the lines are distinctly graceful.

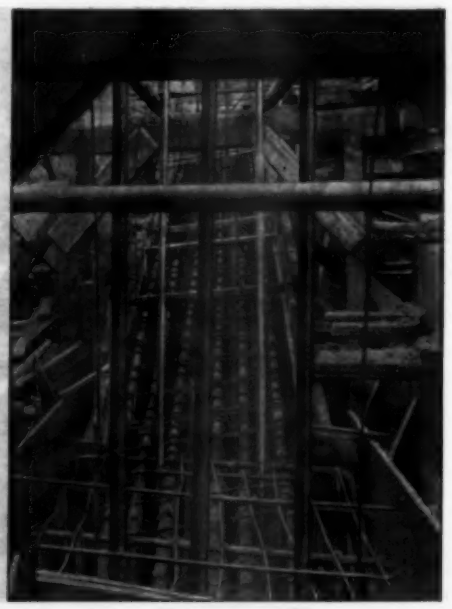


FIG. 5—REINFORCEMENT AT SPRINGING—INSIDE RIB

We may add, in conclusion, that though the bridge since its completion has not been subjected to such a heavy flood as that which, as mentioned above, reached a level of 36.4ft. above Ordnance Datum in 1875, yet it has safely withstood a flood of no inconsiderable magnitude. At the end of last year the river Trent was in flood for a somewhat extended period, the highest water level being reached in the last week in the year, when the top mark was 33.73ft. above Ordnance Datum, or 3.23 above the springing of the arches.

We are indebted to Mr. Cracroft Haller for the major portion of the particulars given above and of the illustrations given herewith and on page 316.

Railway Matters.

THE third annual congress of the Institute of Transport will be held at Sheffield on June 14th, 15th and 16th. The annual dinner is to take place in London on May 3rd.

THE train on which the Midland coaches run, to which reference was made in this column on February 16th, is the 12.5 p.m. Manchester, London-road, to Euston, *viâ* Stoke.

MEMBERS of the British Association going to the Liverpool meeting in September next will, according to a recent announcement of the railway companies, be able to travel at a single fare and one-third for the double journey.

TRAINS of coal for London are now worked throughout from Toton Sidings, at the southern end of the Erewash Valley, to Willesden by engines, brakes and men belonging to the Midland Section of the London, Midland and Scottish Railway Company.

A STEAMSHIP and railway terminus equipped with the latest devices for rapid loading and unloading of railway cars and ships will be constructed on the Hudson River between 54th and 55th streets by a New York syndicate. The terminus will cost 10,000,000 dollars, and work upon it will begin at once.

A VERY nice action is related of Mr. W. H. Cox, of Snaigow, the chairman of the Highland Railway and Lord Invernairn, a fellow director. They have jointly given the £1053 that has been paid them as compensation for disturbance of office, to endow a "Highland Railway Bed" in the Inverness Infirmary.

THE scheme for electrifying the Temiskaming and Northern Ontario Railway involves the development of three water falls having a total capacity of 25,000 horsepower, and with heads ranging from 50ft. to 130ft., at a cost of, roughly, 3,000,000 dollars. Power will be transmitted at 66,000 volts and distributed by 3000-volt direct-current.

THE Indian Government has been defeated on its proposals to take over the Great Indian Peninsula and the East Indian Railways when their contracts expire. The Commerce Member said that this proposal was tentative only and was not to be accepted definitely as favouring State management. An amendment for full State management of these lines was moved and carried by 56 votes to 42.

THE change in the train services between Euston and Manchester, mentioned in this column on the 16th inst., comes into operation on April 2nd, and is not as great as we were led to believe. The 9.45 a.m. from Manchester (London-road) to Euston, and the 6.5 p.m. Euston to Manchester, are to be timed for 3 hours 30 min.; the 5.55 p.m. Euston to Liverpool for 3 hours 40 min.; and the 8.55 a.m. from Birkenhead (Woodside) to Euston for 4 hours 5 min.

ON October 24th, 1921, a London and North-Western engine failed when passing through the tunnel under the Sugar Loaf, and the fireman became unconscious through asphyxiation. Signal-Inspector Brown was on the train and by his prompt action saved the man's life. At a recent competition of the Central Wales district of the St. John's Ambulance Association, a certificate for his valuable services was given to Mr. Brown, who is a member of the Builth-road team.

THE fourth serious derailment within recent years on the Portpatrick and Wigtownshire Joint Railway occurred on December 28th under circumstances as to which Major Hall has just reported. It arose from a combination of high speed, a road slightly wide to gauge, and the presence of four-wheeled vehicles in front of heavier stock. A possible further factor was insufficient play between the axle-box and the horn-block bridle to obviate any risk of a wheel being lifted when oscillation was set up.

THE vacancy created by Mr. R. H. Whitelegg, the chief mechanical engineer of the Glasgow and South-Western Section of the London, Midland and Scottish Railway Company, going to Beyer, Peacock and Co., Limited, as general manager, will not be filled, as Mr. Pickersgill of the Caledonian section has been made mechanical engineer (Northern Division), with Mr. D. C. Urie, of the Highland, assistant mechanical engineer (Northern Division). Mr. Whitelegg entered on his new duties on the 1st inst.

ON the 6th inst., Lieut.-Colonel Ashley, answering a question as to the use of non-inflammable material in rolling stock, said it was only required for cars in use on tube railways. It was not considered by the Ministry of Transport to be necessary for main line coaches. Various recommendations had, from time to time, been made to the main line companies as to the precautions it was desirable they should take against the danger of fire, and he had no doubt that the companies were fully alive to their responsibility in the matter.

IT is officially announced that Mr. D. McLellan—late the southern and eastern divisional engineer of the Caledonian Railway—has been appointed divisional engineer (Caledonian and Glasgow and South-Western sections) of the London, Midland and Scottish Railway Company. Mr. A. Newlands remains at Inverness and ranks as divisional engineer (Highland section). This announcement implies that, in addition to Mr. Paterson, chief engineer Caledonian Railway, retiring, as intimated on page 109 of our issue of February 2nd, Mr. T. Keeling, the chief engineer of the Glasgow and South-Western, has left also.

THE report by Lieut.-Colonel Mount on the accident of January 13th at Porth, Taff Vale section of the Great Western Railway, mentioned herein on January 26th, was issued on the 15th inst. This was a case where a mineral train got out of control. The responsibility for stopping to pin down brakes when descending the severe gradient from the Treherbert direction is placed on the driver. It is usual to omit this stop if the load does not exceed thirty-five wagons. In this case there were thirty wagons and a dead locomotive weighing 17 tons. The train, however, got out of control. It has now been arranged that all mineral trains, regardless of their loads, shall stop for brakes to be pinned down.

Notes and Memoranda.

THE preliminary statistics of accidents in the mines of the Witwatersrand show that during the past seven years the proportion of fatal accidents has fallen from 3.17 to 2.28 per thousand.

THE recent opening of the new building of the Liverpool University provides five chemical laboratories, but it is estimated that a further £175,000 will have to be expended before the original scheme can be completed.

NOTWITHSTANDING the chaotic condition of affairs in the interior of China and the insolvent state of the Government, the Maritime Customs Revenue for 1922 amounted to Haikwan Taels 58,600,000, or at the average exchange of 3s. 9d., £10,987,500. This shows an increase of Haikwan Taels 4,100,000 on the previous record collection in 1921, although, as a result of the drop in exchange, the gold equivalent in 1922 was only £215,235 more than in 1921.

NEARLY ten million dollars have been spent on the waterworks system of the city of Montreal. At the present moment, according to the *Canadian Engineer*, contracts are being carried out amounting to an additional one million dollars, and, at the next meeting of the City Council a by-law will be submitted by the Executive Committee authorising them to hand over to the Water Board a further one million dollars to be spent during the current year. Several millions more will be required to complete the scheme.

AN exhibition of foreign-made files, collected by the Overseas Trade Department, has just been held at Sheffield. The American files made a good impression, according to the *Ironmonger*, and were admitted to offer formidable competition to British makers, alike in quality and price. They are lighter than English files, and therefore cost less to produce and transport. In this country, we adhere to the old heavy file, mainly because it is thick enough to allow of re-cutting when the teeth are worn. America disregards that consideration.

AN important step has been taken in connection with the scheme for the proposed new harbour at Vizagapatam. A large area of swamp land, some 5000 acres in extent, has been acquired by the Bengal-Nagpur Railway Company for the construction of the harbour, while further areas are now being acquired up to a total of 10,000 acres. It is proposed to construct berths for three steamers, but the site allows for ten times that number. The scheme will give a 30ft. depth of water at all times of the tide, and includes the establishment of a large oil depôt.

THE output of Portland cement in the United States during last year was 113,870,000 barrels, while shipments were 116,563,000 barrels, representing an increase of 14.2 per cent. and 21.4 per cent. respectively over 1920, the best previous year. The latest information available as to the productive capacity of the mills is that shown in the report of the Geological Survey for the year 1921—141,984,000 barrels—which would indicate that approximately 80 per cent. of the capacity was employed during 1922. This does not take into consideration additional capacity constructed since 1921.

A NEW material which is being used in America for the coach work of motor cars is described as follows in the *Autocar*:—A conventional wood framing is employed, and is covered with a foundation of wire mesh. Over the wire is placed one layer of cotton wadding, and over this again buckram is fastened. The final covering is a fabric resembling leather. The weight of a body so constructed is slightly less than that of a similar body with aluminium panels. The weight of the combined wire, buckram, and fabric covering is under ¾lb. per square foot. Another great advantage is that the time usually needed for painting is saved.

ACCORDING to a local South African Dutch paper, a large scheme is being developed in the eastern Transvaal for shipping coal, utilising Kosi Bay, in Tongaland (distant 200 miles), for shipment. The scheme includes a pipe line starting from Lake Chrissie, in the Ermelo district, Eastern Transvaal, for the conveyance of crushed coal. Power would be derived from the Usutu River. Chemical works would be established at Kosi Bay for the recovery of by-products; there would also be an extensive railway system parallel to the pipe line. Coal for export would be conveyed by rail. The capital involved is given as £26,500,000, chiefly American, although a British syndicate is stated to be also interested in the project.

ACCORDING to a report by Dr. J. H. James, head of the Department of Chemical Engineering of the Carnegie Institute of Technology, and mentioned in the *Chemical Trades Journal*, "oxidised kerosenes cause less 'knocking' than straight kerosene when used in a kerosene engine. His test also shows that oxidised kerosene generates approximately the same power as ordinary kerosene, in spite of the fact that its theoretical thermal value is one-eighth less. Dr. James attributes this high efficiency to the more complete combustion attained by these partly oxidised fuels. The success of this experimental work gives promise that oxidised kerosene, which is manufactured by catalytic oxidation from low-grade petroleum, may become a useful fuel for kerosene engines or for blending with gasoline."

THE extreme opaquing or hiding power of the white pigment, titanic oxide, when mixed with oil, is mentioned in an article by Mr. Andrew Thompson, in *Engineers and Engineering*; but it was found, he says, that it would be practically impossible to manufacture titanic oxide to compete with other opaque white pigments. Further research demonstrated that a composite pigment consisiting of only 25 per cent. of titanic oxide thrown down on a base of precipitated barium sulphate, probably because of the wonderful fineness of the particles and maximum distribution of the titanic oxide, actually had approximately 80 per cent. of the hiding power of a pigment consisting of 100 per cent. titanic oxide. Tests to demonstrate the availability of this composite titanium pigment brought out the fact that such a pigment had greater hiding power than any white pigment known, was exceedingly inert to various vehicles—oils, &c.—and other pigments, was non-poisonous, and had many properties which made it unique among pigments.

Miscellanea.

THE Brodsworth Colliery, near Doncaster, is said to have eclipsed all previous records with an output of no less than 29,154 tons 19 cwt. for one week.

THE Canadian Government proposes to begin work on section eight of the new Welland ship canal early in the spring. This section is in the vicinity of Humberstone Village, and covers 2 miles.

IT is proposed to erect a three-kiln cement plant at Aberthaw, near Barry. The cost will be in the neighbourhood of £750,000, and an annual output of over 150,000 tons is anticipated.

THE log output of British Columbia last year showed an increase of 164,000,000ft. over the total for 1921. The 1922 returns show a scale of 1,645,000,000ft. of saw-logs. The total for the previous year was 1,481,000,000ft.

DURING the past few days coke supplies from the East Coast have been short, and in consequence three furnaces operating at the Millom Ironworks have been damped down, but it is hoped to restart them shortly.

FURTHER developments are contemplated at the Renishaw ironworks, near Sheffield. A contract has been placed for a new blast-furnace capable of an output of 1000 tons a week, four Cowper stoves, and a 32,000 cubic feet per minute air compressor.

A NEW bridge is to be built across the Niagara River. It will be of the two-hinged arch type and close alongside the existing cantilever bridge of the Michigan Central Railroad. The span is to be 640ft., and the track 240ft. above the water level. The depth of the arch itself will be 105ft.

THE turbines for the proposed Winnipeg Hydro standby plant are to be manufactured in Glasgow. The prices quoted for 5000-kilowatt turbines and one 1000-kilowatt house turbine aggregated 203,150 dollars and represented the lowest satisfactory tender. The new plant will not be in operation before the summer of 1924.

THE British Empire Steel Corporation contemplates the erection of wireless stations at Sydney, Nova Scotia, and at Bell Island, Newfoundland, by means of which communication will be maintained with the company's fleet of steamers, and also between the head office at Sydney, N.S., and the iron mines at Bell Island.

THE Metropolitan Water Board has approved of a scheme involving an expenditure of £1,434,920 for the improvement of the water supply north of the Thames. The chief item of expenditure will be the provision of a 48in. main from Kempton to Cricklewood—about 12 miles—at an estimated cost of £422,500; and pumping station buildings at Kempton, to cost £125,000. The scheme will make possible a saving of about £30,000 a year.

WORK in connection with the powerful wireless station which is being installed at Antananarivo, on the central plateau of Madagascar, is going on rapidly. Eight pylons, 795ft. high, form the transmitting station, and when the surrounding buildings are completed, they will form a little town, some 3 miles outside the capital, housing fifty white members of the staff and five hundred natives. The installation of the apparatus will not be completed for several months.

WRITING to one of the evening papers a correspondent says that it is believed that the Peninsular and Orient steamship Walders has just established a world's coaling record at Port Said. One thousand three hundred and ninety tons of coal were put in in two hours. Three hundred and twenty men were employed on the lighters, working twelve chutes, and one hundred men were engaged in trimming the coal in the bunkers. This works out at the rate of 695 tons per hour.

KEEN satisfaction is expressed in official circles in Australia at the decision of the Imperial Government, recently announced in the House of Commons by Mr. Amery, to create at Singapore a naval base capable of dealing with modern ships. Mr. Bruce, the Prime Minister, beyond expressing pleasure at the announcement, declined to make any further comment, saying that the whole policy of Empire defence would be raised at the forthcoming Imperial Conference.

THE construction of the big Canadian Dominion Government dry dock at Esquimalt, Vancouver Island, has been delayed several weeks, according to the *Canadian Shipping News*, by the breaking of the cofferdam. Two hundred feet of the 500ft. dam collapsed, the cause being the sudden sinking, under the weight of the dam itself and of the sea water pressing upon its seaward face, of the foundations, which had been considered already sunk to their limit into the mud of the harbour bottom.

DEPOSITS of asbestos are said to exist in many parts of the State of Western Australia, the best being found in the Pilbarra district, about 600 miles north of Perth, according to the United States Consul at Adelaide. Both the quantity and the quality of the product found vary considerably, and it is rare that any mine yields more than a few hundredweights a month. Prospects for the industry, however, have been sufficiently promising for a Sydney firm to establish asbestos works outside Perth for the manufacture of asbestos sheets, roofing tiles, and other construction utilities.

IN presenting the report for 1922, dealing with the sixty-eighth year's practical work of the Association, the committee of the Manchester Steam Users' Association congratulates the members upon the continued high position the Association holds among steam users and others. The revenue has been well maintained, the total income for the year reaching a figure not hitherto attained, and the net surplus, after meeting all expenditure, of both ordinary and special character, amounted to £3554 12s. 5½d., which has been added to the reserve fund, the latter now standing at £43,112 17s. 3d. As the assets of the Association, as represented by securities in railway and other stocks, have not been adjusted in recent years, the committee decided they should be re-valued at the close of the year, and their values, as shown in the present balance sheet, are strictly in accordance with Stock Exchange prices ruling on December 31st, 1922.

MUSKHAM BRIDGES ON THE GREAT NORTH ROAD

(For description see page 313)

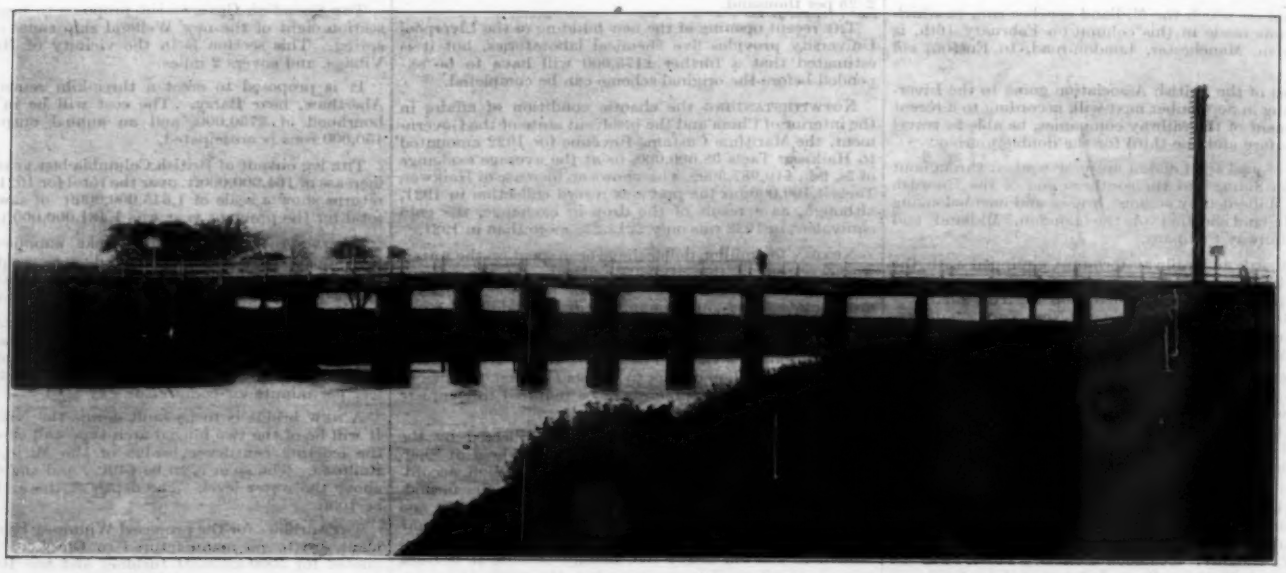


FIG. 6—THE OLD WOODEN BRIDGE, BUILT IN 1662

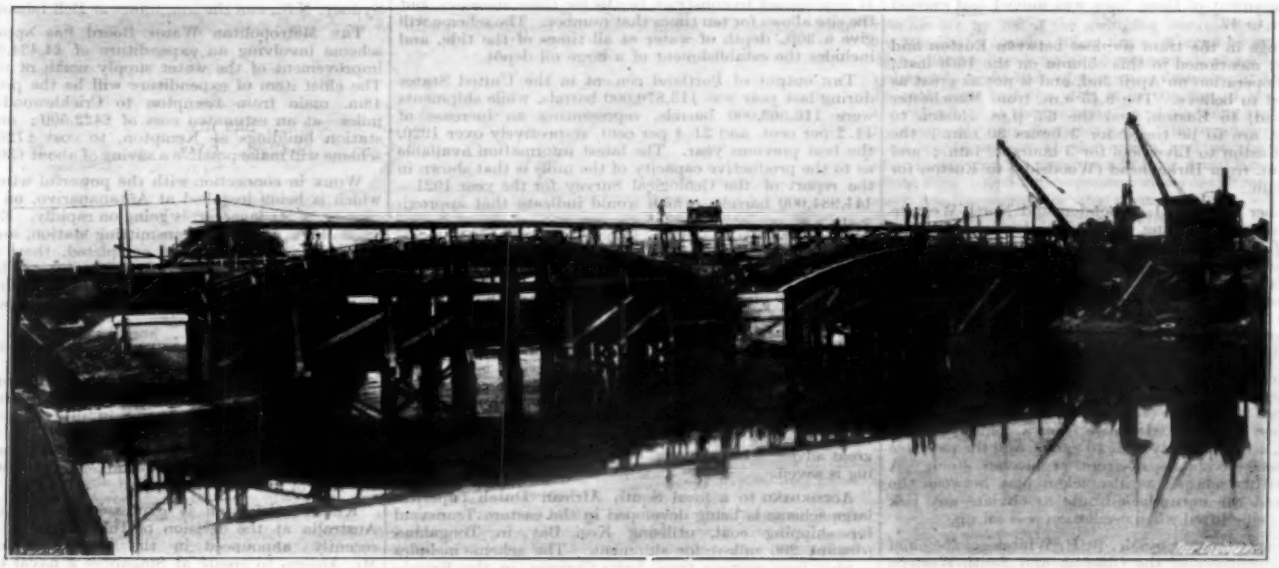


FIG. 7—THE NEW BRIDGE UNDER CONSTRUCTION SHOWING FALSEWORK AND CENTERING

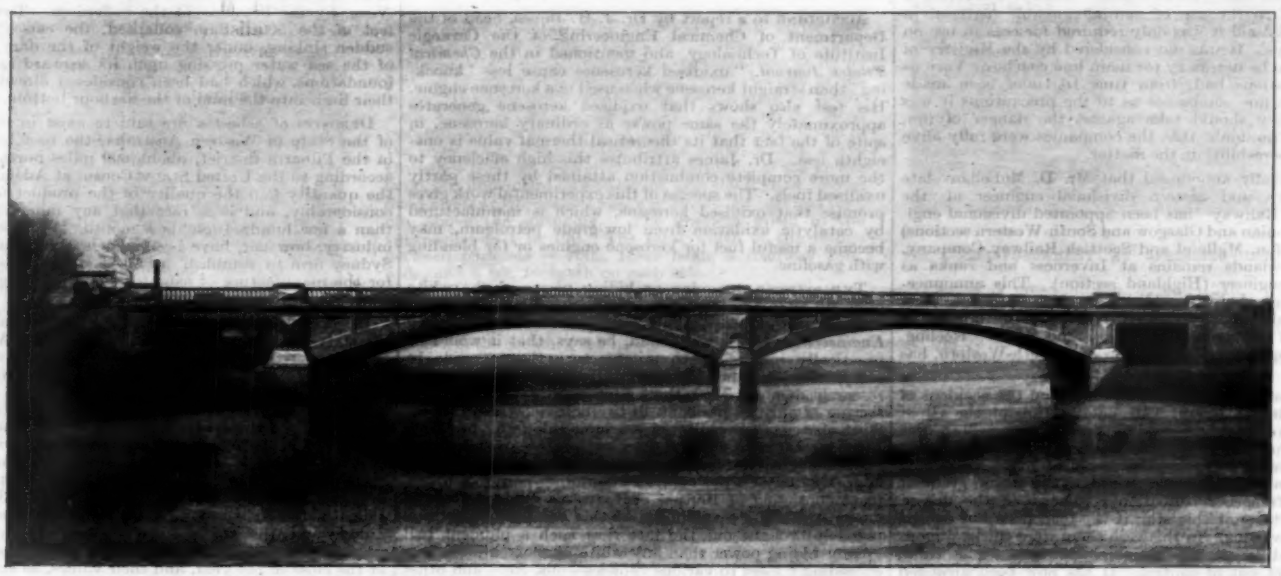


FIG. 8—THE NEW BRIDGE COMPLETED

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The Engineer

BUENOS AIRES.—MITCHELL'S BOOK STORE, 576, Cangallo.
CHINA.—KELLY AND WALSH, Limited, Shanghai and Hong Kong.
EGYPT.—CAIRO EXPRESS AGENCY, near Shepheard's Hotel, Cairo.
FRANCE.—BOYVEAU AND CHEVILLET, Rue de la Banque, Paris.
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BELGIUM.—W. H. SMITH AND SON, 78/80, Rue du Marché-aux-Herbes, Bruxelles, and 44, Rue Joseph II., Ostend.
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ITALY.—MAGLIONI AND STRINI, 307, Corso, Rome; FRATELLI TREVES, Corso Umberto 1, 174, Rome; FRATELLI BOCCA, Rome; ULRICO HOEPLI, Milan.
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FRANCE.—AGENCE VOX, 7, Rue de Surène, Paris (VIIIe).
BELGIUM.—W. H. SMITH AND SON, 78/80, Rue du Marché-aux-Herbes, Bruxelles, and 44, Rue Joseph II., Ostend.

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Small Advertisements cannot be inserted unless delivered before TWO o'clock on Thursday afternoon (the day before publication). ALTERATIONS to STANDING ADVERTISEMENTS must arrive not later than THURSDAY of the week preceding publication.

Letters relating to Advertisements and the Publishing Department of the Paper are to be addressed to the Manager, all other letters to be addressed to the Editor of THE ENGINEER.

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PUBLISHER'S NOTICES.

*** *With this week's number is issued as a Supplement a Two-page Plate illustrating the Salving of the Brazilian-Lloyd Ship Avare in Hamburg Harbour. Every number as issued by the Publisher contains a copy of this Supplement, and Subscribers are requested to notify the fact should they not receive it.*

TO CORRESPONDENTS.

*** *All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

*** *We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

By arrangement with Reuter's Engineering Service, **The Engineer** *contains the latest news from all parts of the world which is likely to be of interest to engineers.*

Contents.

THE ENGINEER, March 23rd, 1923.	PAGE
CONDENSING AND UTILISATION OF EXHAUST STEAM IN LOCOMOTIVES.—No. II. (Illus.)	303
BOMBAY WATER SUPPLY.—No. II. (Illus.)	304
INSTITUTE OF METALS.—No. III.	305
A DEVELOPMENT OF THE CYC-ARC WELDING PROCESS. (Illus.)	306
INSTITUTION OF NAVAL ARCHITECTS.—No. I.	309
A SEVEN-DAY JOURNAL	311
SALVING THE AVARE. (Illus.)	312
NEW BRIDGE AT MUSKHAM ON THE GREAT NORTH ROAD. (Illus.)	313
RAILWAY MATTERS	315
NOTES AND MEMORANDA	315
MISCELLANEA	315
LEADING ARTICLE—	
Engineers as Capitalists	317
THE ELECTRIFICATION OF THE HUNGARIAN STATE RAILWAYS	318
BOOKS RECEIVED	318
INSTITUTION OF MECHANICAL ENGINEERS. (Illus.)	319
AN AUTOMATIC STONE DRYING AND TARRING PLANT. (Illus.)	321
INSTITUTION OF ELECTRICAL ENGINEERS—SUMMER MEETING	322
ELECTRICAL DEVELOPMENT ASSOCIATION	322
CATALOGUES	322
A PROPOSED AIRCRAFT CARRYING MAIL STEAMER. (Illus.)	323
PROVINCIAL LETTERS—	
The Midlands and Staffordshire	325
Lancashire	325
Sheffield	326
North of England	326
Scotland	327
Wales and Adjoining Counties	327
LATEST NEWS FROM THE PROVINCES	327
CURRENT PRICES FOR METALS AND FUELS	328
FRENCH ENGINEERING NOTES	329
BRITISH PATENT SPECIFICATIONS. (Illus.)	329
LAUNCHES AND TRIAL TRIPS	330
PERSONAL AND BUSINESS ANNOUNCEMENTS	330
FORTHCOMING ENGAGEMENTS	330
CONTRACTS	330
PARAGRAPHS—	
The Institution of Electrical Engineers	322
The Beama Dinner	322
Alloys Resistance to Corrosion	330

TWO-PAGE SUPPLEMENT—SALVING THE BRAZILIAN LLOYD SHIP AVARE IN HAMBURG HARBOUR.

THE ENGINEER.

MARCH 23, 1923.

Engineers as Capitalists.

THE Government is to be commended for its decision to give time in the present session for a debate in the House of Commons on the destruction of capitalism. Howsoever severely we may criticise, according to our divergent views, the works of Parliament, and howsoever warmly we may express our dislike of the political game, yet, one and all, we admit that the House of Commons is the finest debating society in the world. Every subject brought before it meets keen examination, none can hope to escape sooner or later from a ruthless and searching inquiry. In the House the methods of the tub in the market-place cease to prevail. The popular orator indeed may be heard with toleration, and even applause for his rhetoric, but there is no chance that his shallow and glittering arguments or false logic will escape the castigation they merit. For this reason, above all others, we rejoice that at last—at a time when the relative strength of the main parties favours such a debate—a question which has been agitated for many years in less responsible quarters has been brought before Parliament itself. Now at length the leading principle of Socialism will be subjected to examination by a body of British gentlemen, amongst whom there is no undue balance in one direction or the other, and the debate will be laid before the public with all the weight and authority which attaches to the acts of the great national assembly. It is well that it should be so, it is well that in a House of almost equally balanced opinion a matter which has agitated the country so deeply for many years past should be discussed, and that arguments which are, unquestionably, gaining ground with certain sections of modern thought should be publicly winnowed.

In laying before the House on Tuesday night his resolution that "legislative effort should be directed to the gradual supersession of the capitalistic system by an industrial and social order based on the public ownership and democratic control of the instruments of production and distribution," Mr. Snowden spoke with a moderation in marked contrast to that with which we have become familiarised by speakers on less weighty occasions. But despite his moderation, he used the same arguments which have served in this cause time out of mind. To some of them we wish to make reply, for what we take to be the excellent reason, first, that the modern industrial system is generally held to have begun with the invention of the steam engine, and, secondly, that amongst the capitalists of the country the great engineering and transport firms are not the least notable and influential. Mr. Snowden opened his indictment of the capitalistic system by charging it with failing to give the people a "good world" in which to live and failing to utilise adequately "natural resources and productive power." In so doing he fell, we suggest, into the very common mistake of contrasting the present with an ideal future instead of with the past. No one will venture to assert that the present world is a "good world" for all the people in it, but looking to that portion of the population which Mr. Snowden had in his eye, we may safely say that it is a far better world than it was a hundred years ago, that the lot of the workers is, in the main, a vast deal better, and that progress has been, and is, consistent and constant. We shall consider in a few moments to whom the improvement is due. We turn now to the second of Mr. Snowden's two charges, and we need not say that as engineers and scientists it fills us with amazement. Indeed, we are so completely at a loss to understand what was in his mind when he made the assertion that capitalism failed "adequately to utilise natural resources and productive power," that we imagine the words mean to him something totally different from what they mean to us. The whole history of engineering is a splendid record of the development of natural resources for the uses and benefit of man, and unless we are to be ashamed of that history, which is unthinkable, we must wholly reject Mr. Snowden's words. Moreover, it is perfectly safe to aver that without capital the development of natural resources would never have been made, and that man to this day would remain in the primeval condition to which Mr. Snowden himself referred. Engineers cannot forget that it was not till Watt, the engineer, allied himself with Boulton, the capitalist, that the development of the greatest of all "resources," the steam engine, became possible. The history of every important invention bears witness to the fact that had the world been controlled by a socialistic government—in which, of course, Labour would have had the greatest weight—progress would have been arrested by the opposition of the artisan classes to every step which led them from the accustomed rut in which they moved. The capitalist favours progress in the hope of gain, the proletariat has invariably opposed it from the dread of change. Even to this day the resources of our factories and our mines—their "productive power," to use Mr. Snowden's own words—is restricted far, far more by the workmen themselves than by the capitalistic owners.

Continuing his indictment, Mr. Snowden said the capitalistic system had "assumed the function of managing industry," and had failed to do it adequately or efficiently. "How could anyone defend a system which was unable to find employment for a million and a-half would-be workers?" Are we to understand by this question and its logical connection, that Mr. Snowden believes that under a socialistic system there would be no periods of unemployment? That in the best of all possible worlds there would always be sufficient profitable occupation for overstocked countries, and always sufficient overseas trade to provide for the needs of an island which depends for its existence on industrialism? If that is his intention, then, we can safely say that unless the whole world is to come under a single control, his ideal is unattainable. It is not capitalistic Britain that is causing unemployment, but socialistic Russia. Bring back to us Russian trade and the Siberian harvest, and unemployment would rapidly disappear. "There was," continued Mr. Snowden, "no sphere in which the capitalist system had more lamentably failed than in providing housing accommodation." To that, the reply is obviously that had the capitalistic system been left alone it would as certainly have provided the houses under the present conditions as it did under the conditions prevailing before the war. But Mr. Snowden dealt particularly with the condition in London, and he overlooked, as so many have done, an essential point in this question. People come to London because they wish to, not because there is any necessity for them to be here. Unsatisfied with provincial or country life, they flock to the Metropolis, and add to the cost and congestion. They could find occupation and accommodation in other cities and other districts, but they will not do so. It is quite reasonable to contend that the time has come when London should endeavour to put a limit to its growth, that it should not be too lavish in its provision of houses, and too ready with its means of transport. About one-eighth of the population of the kingdom is centred in London. It would be better if the development of other cities was encouraged, and that of London restricted.

Let us turn now for a moment to the question of wages. In common with his fellows, Mr. Snowden held the capitalistic system responsible for their

lowness, but he made no effort to show how under a socialistic state they could be raised. We assume, of course, that he is far too good an economist to imagine that the profits of capitalists could appreciably and permanently affect the wages bill of the country. But failing that source of revenue, we can see but one way of increasing wages, and that why is as fully open under the present system as under any ideal system. It is, of course, by working harder. A general adoption of payment by results would lead immediately to the increase of wages and to the augmentation of production. Labour has opposed both these things. It looks with dislike on piecework, premium-bonus and profit-sharing plans, and winks at "ca' canny" and the restriction of output. Would Mr. Snowden have us believe that in a socialistic state workers would always do their best for no extra remuneration at all, or for a problematic gain in communal welfare, less attractive and less great than the capitalist is willing to give them now?

It is the familiar practice of the anti-capitalist to select from the past some of the horrors of factory life and by suggestion to project them into the present, so that they cast a baneful shadow upon the capitalists of his time. Nothing could be more grossly unfair to the employers of to-day or unjust to those of the past. Every age must be measured by its own scale, and to condemn the factory conditions of a hundred years ago because they are not what we should tolerate to-day, is as foolish as despising the science of the age of Bacon because it was far behind that of the age of Kelvin. But in the progress from that condition, the employers, not the workpeople, have always been the prime movers. The names of Lord Shaftesbury, of Fielden and Brotherton, of Dale, and of Owen are the names of employers of labour, not of workmen suffering in Early Victorian factories. Sir Robert Peel, in introducing factory legislation in 1815, spoke as an employer. It is to John Wood, of Bradford, more than to Oastler, that we owe the improvement of the lot of children in factories, but Wood was a mill owner. "It happened," says Miss Proud in her book on "Welfare Work," "that the first Factory Bill (1802) and the first successful Ten Hours Bill were both piloted through Parliament by men who were employers," and it was the work of employers throughout the manufacturing districts to convince the country that legislation was of fundamental importance. Successive Factory Acts have been brought in and passed by Governments in which the capitalistic element was quite powerful enough to throw them out, if it so desired. It did not do so, and, moreover, the best employers, who invariably set an example which is followed by others, have always gone further than the Acts and provided amenities or improved conditions far in advance of the legislative requirements. It is to the employers that we owe the welfare work of to-day, and employers have provided out of their own means recreation grounds, concert halls, clubs and institutions, canteens and wash-houses. In the face of these well-known facts, to hold the capitalist employer up for execration is as unjust as it is foolish to believe that under any form of State control better conditions would be offered than are presented now by all but the worst factories. That bad factories do exist, we know all too well. Some that are a disgrace to our country are to be found in such a great city as Sheffield, and in even a greater city like London. But if they are examined they will be found to be the property of very small capitalists and to be rather classifiable as "family" concerns than as factories; they are the survivors of a system that has been swept out of existence by the capitalistic system rather than as fair examples of that system as it exists to-day.

The Electrification of the Hungarian State Railways.*

By L. VON VEREBELY, Director of the Hungarian Railway Electrification Bureau.

THE official intention to electrify certain Hungarian State lines dates from the late war. Although Magyar engineers since 1902 had had great success on Italian three-phase railways, the Austro-Hungarian War Ministry had prevented railway electrification in the Dual Monarchy. When coal scarcity and economic difficulties made the problem urgent, delays and difficulties arose from the Bolshevist *régime* and from the Peace Treaty, which deprived Hungary of its oil and gas resources, of 95 per cent. of its available water power, and of 68 per cent. of its coal deposits. As a result, electrification plans have now to be based almost exclusively on lignite deposits of too poor a quality for other uses. The lines suitable for electrification are the following:—

	Kilom.
Budapest–Bruck	219.3
Budapest–Ujdombovár	159.1
Budapest–Szabadka	167.0
Budapest–Szolnok	100.7
Cegléd–Szeged	118.0
Szolnok–Nagyvárad	146.0
Szajal–Arad	142.6
Rákos–Szolnok	92.2
Budapest–Hatvan	68.5
Hatvan–Salgótarján	56.2
Hatvan–Miskolc	115.4
Total	1385.0

All these lines are in the plains, with gradients not exceeding 8 in 1000. In 1913 the total traffic was nearly 9,000,000 ton-kilometres. Careful calculations show that, with the new system outlined below, the average energy consumption will be 33 watt-hours per ton-kilometre, so that for the 1913 traffic 292.7 million units would be required. Three-phase energy is to be generated at 50 cycles and supplied to the State network, which is to provide for the needs of the railways, industries, and other users. With the expected load factor, the consumption, based on locomotive coal, will be 1.3 kilos. per kilowatt-hour. The coal saving on the railways can be taken as 60 per cent., while otherwise useless lignite and peat will be utilised.

Until work on a wide scale is possible an experimental line is being equipped. For reasons of economy the fuel-operated stations with large units will supply energy only as three-phase current at 50 cycles, and it is not expected that traction load will prove undesirable on the general network.

In order to utilise the 50-cycle supply for the railways without conversion into either direct current or a form suitable for one-phase commutator motors there remained only the 50-cycle, three-phase system, or the 50-cycle, split-phase system—as used on the Norfolk and Western Railroad. As the former needed double overhead construction and entailed a low power factor, Von Kando had developed a new split-phase converter for use with gearless locomotives to permit of the combination of a single-phase overhead conductor with three-phase, 50-cycle induction motors.

The following reasons have led the Hungarian State Railways to experiment with this system:—

(1) The three-phase motors work at constant and highest efficiency over a wide range of load.

(2) The power factor at the collector bow is independent of the power factor of the motor, so that slow-speed, 50-cycle, gearless motors can be used. Further, this permits independent automatic regulation of the power factor of the traction load.

(3) The voltage at the motor terminals is independent of the overhead supply voltage over a wide range, so that sub-stations can be placed far apart.

(4) As the motor current is largely independent of the overhead current, the motors can be designed for the best conditions of saturation, efficiency, &c.

(5) The short-circuit current of the converter is smaller than the full-load current, so that the effect on the station is harmless when the converters fall out of step. When this occurs the motors are automatically cut out, and the unloaded converter pulls into step again before the motor switch re-closes.

The above properties are valuable for a case where the traction load is to be drawn from a general three-phase supply, while unbalancing will be reduced so far as possible by suitable distribution of the single-phase load over the three phases.

Before arriving at a decision regarding the new system experiments will be shortly conducted on a track equipped with one-phase at 50 cycles and 15,000 volts, the locomotive and transformer station being supplied by Messrs. Ganz, of Budapest. The chief data of the locomotive are:—

Axle arrangement	0 E 0
Length over buffers	9640 mm.
Diameter of drivers	1070 mm.
Total = adhesive weight	72 tons
Tractive effort at starting	20,000 kilos.
Speeds	25, 33⅓, 50, 66⅔ kiloms. per hour
Hourly rating	2720 H.P.
Specific rating	37.8 H.P. per ton
Number of motors	Two
Driving mechanism	Scotch yoke

The motors have forced ventilation On both stator and rotor there are two independent three-phase windings with eighteen and six poles respectively. By cascade connection in each motor or between the two motors, forty-eight, thirty-six, twenty-four, or eighteen poles are obtained, which give the four speeds mentioned. The speed controller is mechanically operated by the driver. The controller arm also actuates the spring of a watt-meter relay, which controls the liquid starting resistance. The converter, mounted above the motors with its shaft parallel to the locomotive axis, is built like a turbo-generator. Its two-pole rotor, excited with direct current, runs at 3000 revolutions per minute. The stator has two windings—a primary motor winding for one-phase at 15,000 volts, and a secondary generator winding for three-phase at 420 to 750 volts. The exciter is direct coupled, its own excitation being automatically regulated so that any desired primary power factor is maintained. Simultaneously the voltage supplied to the motors is varied in accordance with the load, thereby attaining the highest corresponding efficiency.

* Abstracted from "Elektrotechnik und Maschinenbau, vol. 41, p. 41.

BOOKS RECEIVED.

Metal Turning Made Easy. London: Cassell and Co., La Belle Sauvage, E.C. 4. Price 1s. 6d. net.

Civil Engineering Geology. By Cyril S. Fox. London: Crosby Lockwood and Son, Stationers' Hall-court, E.C. 4. Price 18s. net.

The "Mechanical World" Year Book, 1923. London: Emmott and Co., Limited, 20, Bedford-street, W.C. 2. Price 1s. 6d. net.

The "Mechanical World" Electrical Pocket Book, 1923. Manchester: Emmott and Co., Limited, 65, King-street. Price 1s. 6d. net.

Internal Combustion Engines. By J. Okill. London: Sir Isaac Pitman and Sons, Limited, Parker-street, Kingsway, W.C. 2. Price 3s. net.

The Diesel Engine. By A. Norton. London: Sir Isaac Pitman and Sons, Limited, Parker-street, Kingsway, W.C. 2. Price 2s. 6d. net.

Structural Steelwork. By Wm. H. Black. London: Sir Isaac Pitman and Sons, Limited, Parker-street, Kingsway. W.C. 2. Price 2s. 6d. net.

The Racing Eight: Notes on its Design and Propulsion. By W. B. Coventry. Cambridge: W. Heffer and Sons, Limited. Price 3s. 6d. net.

Cements and Artificial Stones. By the late J. Watson. Edited by R. H. Rastall. Cambridge: W. Heffer and Sons, Limited. Price 6s. net.

Vector Calculus, with Applications to Physics. By J. B. Shaw. London: Constable and Co., Limited, 10, Orange-street, Leicester-square, W.C. 2. Price 14s. net.

The Industrial Court: Practice and Procedure. By Sir William Mackenzie. London: Butterworth and Co., Bell-yard, Temple Bar, E.C. Price 2s. 6d. net.

Heizungs-und Lüftungsanlagen in Fabriken. Von Oberingenieur Valerius Hüttig. Leipzig: Verlag von Otto Spamer. Prices, Marks 10,500 and Marks 13,300.

Elasticity and Strength of Materials used in Engineering Construction. Section 1. By C. A. P. Turner. Minneapolis, Minn.: The C. A. P. Turner Company. Price 5 dols.

Allgemeine Maschinenlehre Vorlesungen über Arbeitsgewinnung und Kraftmaschinen. Von Hugo Fischer. Leipzig: Verlag von Otto Spamer. Price, Marks 6300 and Marks 8400.

A List of English Clubs in all Parts of the World for 1923. By E. C. Austin-Leigh. London: Spottiswoode, Ballantyne and Co., Limited, New Street-square, E.C. 4. Price 7s. 6d. net.

Structural Design in Theory and Practice. By Henry Adams. Second edition. London: Constable and Co., Limited, 10, Orange-street, Leicester-square, W.C. 2. Price 10s. 6d. net.

Oil Power. By Sydney H. North. Pitman's Common Commodities and Industries Series. London: Sir Isaac Pitman and Sons, Limited, Parker-street, Kingsway, W.C. 2. Price 3s. net.

The People's Year Book, 1923, and Annual of the English and Scottish Wholesale Societies. Manchester: The Co-operative Wholesale Society, Limited, 1, Balloon-street. Price 3s. net.

Report on the Sierra Leone Government Railway. By Lieut.-Colonel F. D. Hammond, C.B.E., D.S.O., Royal Engineers. London: The Crown Agents for the Colonies, 4, Millbank, S.W. 1. Price 5s.

The "Practical Engineer" Mechanical Pocket Book and Diary, 1923. Edited by Ernest G. Beck. London: Henry Frowde and Hodder and Stoughton, The Lancet Building, 1, Bedford-street, W.C. 2. Prices 2s. 6d. net and 3s. net.

The "Practical Engineer" Electrical Pocket Book and Diary for 1923. Edited by Conrad Arnold. London: Henry Frowde and Hodder and Stoughton, The Lancet Building, 1, Bedford-street, W.C. 2. Prices 2s. 6d. net and 3s. net.

Mechanical Testing. A treatise in two volumes. By R. G. Batson and J. H. Hyde. Vol. II.: Testing of Prime Movers, Machines, Structures and Engineering Apparatus. London: Chapman and Hall, Limited, 11, Henrietta-street, W.C. 2. Price 25s. net.

Mechanical Engineering Detail Tables. "A compilation based on many years' experience and intended for the use of designers, draughtsmen and works managers." By John P. Ross. London: Sir Isaac Pitman and Sons, Limited, Parker-street, Kingsway, W.C. 2. Price 7s. 6d. net.

Barnett House Papers, No. 7: Scientific Management and the Engineering Situation. Sidney Ball Memorial Lecture delivered before the University of Oxford, October 28th, 1922. By Sir William Ashley. London: Humphrey Milford, Oxford University Press, Amen-corner, E.C. 4. Price 1s. net.

Crystallisation of Metals. Being a course of advanced lectures in metallurgy delivered at the Royal School of Mines by Colonel N. T. Belaiew, C.B., with a preface by Professor H. C. H. Carpenter, F.R.S. London: University of London Press, Limited, 17, Warwick-square, E.C. 4. Price 7s. 6d. net.

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Institution of Mechanical Engineers.

THE meeting of the Institution of Mechanical Engineers last Friday night in London had before it for discussion the second report of the Steam Nozzles Research Committee. That Committee's first report, it may here be remarked, has only just reached the majority of the members, for it was not presented at a meeting of the Institution, but was "selected for publication" in the "Proceedings," and appears in the first volume of the *Journal* for the current year. The two reports are necessarily complementary, and it is certainly the case that some of the audience at last Friday's meeting found it difficult, if not impossible, to follow the second report by reason of the fact that they had not had sufficient opportunity of studying the first. Below we give a summary which we have specially prepared with the object of setting before our readers the gist of the two reports, with the hope that, should they desire further information and detailed figures, they will consult the original documents. By way of introduction it may be said that the Committee was formed in 1914 as an outcome of a suggestion made in connection with a paper on the flow of steam through nozzles read before the Institution in 1912 by Professor (now Sir) James B. Henderson. Little work on the subject was done by the Committee during the war, and after it the moulders, and miners' strike delayed matters until September, 1921, when actual experimenting was begun. The bulk of the experimental work was, and is being, conducted at the Dickinson-street power station, Manchester, through the courtesy of the Corporation's Electricity Committee.

Last Friday's proceedings were opened by Professor Gerald Stoney, who, as the Committee's reporter, was called upon to present an abstract of the second report. In doing so he remarked that at the time when the Committee was appointed there was little trustworthy information available regarding the flow of steam through convergent nozzles, and that what data had been accumulated by different experimenters were, as he showed by means of a diagram thrown on the screen, largely incomparable by reason of the different methods and different forms of nozzle used in their determination. The summary below may be regarded as an extension of Professor Stoney's subsequent remarks.

STEAM NOZZLES RESEARCH.

In order to discover the efficiency of steam nozzles suitable for turbines it is necessary to determine experimentally (1) the average actual velocity of the steam at or near the nozzle exit, and (2) the theoretical velocity at the same point. To determine the actual velocity the impulse F of the jet against a pressure plate and the discharge m were measured, the velocity being calculated from the formula $C_a = F\ g/m$. The theoretical velocity was determined by equating the kinetic energy of the jet with the mechanical equivalent of the adiabatic heat drop d H through the nozzle in accordance with the formula $C = 300 \cdot 2 \sqrt{d}$ H. The heat drop for this purpose was calculated from Professor Callendar's formula for the total heat of dry steam, namely, $H = A\,T - f(T)\,P + K$, and therefore required a knowledge of the pressures and temperatures on the two sides of the nozzle. The initial temperature and the two pressures were determined experimentally, but the exit temperature was derived from the fundamental adiabatic relation $T_2 = T_1 (P_2/P_1)^{2/13}$. The velocity coefficient was given by the ratio C_a/C, and the efficiency of the nozzle was taken as equal to the square of this ratio.

The apparatus used for the measurement of the impulse of the jet is illustrated in Fig. 1. The nozzle box 1 is bolted to a pipe 2 of large dimensions, the steam from the nozzles being directed on to the base plate of the impulse cage 3. The impulse is transmitted to the weighing lever 4 by the spindle 5, which passes through a gland 6 containing a gun-metal bush 7 rotated at about 80 revolutions per minute by a small electric motor through worm gearing. The spindle 5 is prevented from rotating and moves vertically practically without friction in the bush. The weighing lever is built up of two side bars and three bicycle hubs 9, 10 and 11. The hub 9 provides the connection with the spindle 5, the hub 10 is the fulcrum, and the hub 11 provides the attachment for a finely calibrated spring whereby final adjustment is effected after the impulse has been measured to within a quarter of a pound by means of a scale pan attached to the other end of the weighing lever. Ultimately it was found possible to obtain readings to an accuracy of one-hundredth of a pound by dispensing with the calibrated spring and relying solely on weights placed in the scale pan. The wire netting 8 is intended to eliminate any eddies remaining in the steam after it has left the impulse cage. The cage itself is designed in such a way that the force on the plate is produced entirely by the impulse of the jet and not at all by its reaction. The base-plate carries twenty layers of wire netting faced with three layers of wire gauze and supports a cage composed of thin strips of 18 S.W.G. aluminium plates separated by washers. With these precautions it was sought to ensure that the steam should leave the cage at a low velocity and entirely at right angles to its original direction of motion.

After some fifty preliminary tests had been carried

FIG. 1.—*Section of Nozzle Tester*

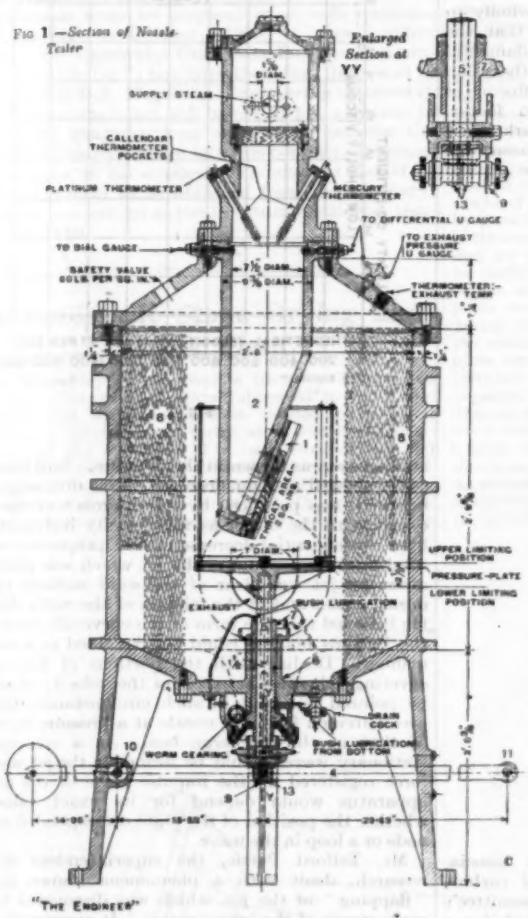


FIG. 2.—Impulse Nozzle-Box.

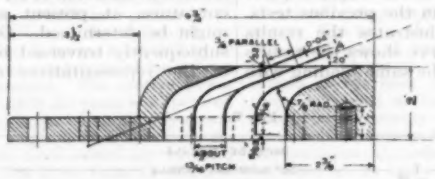
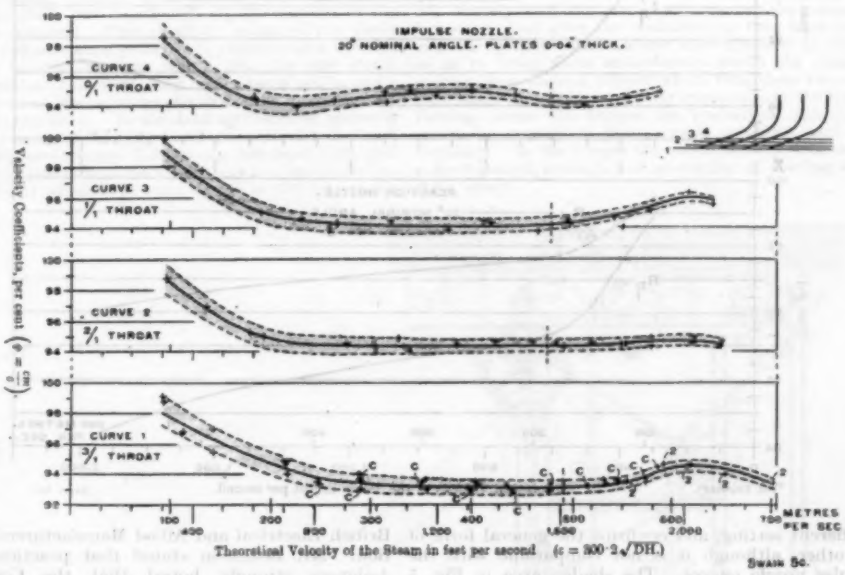


FIG. 3.



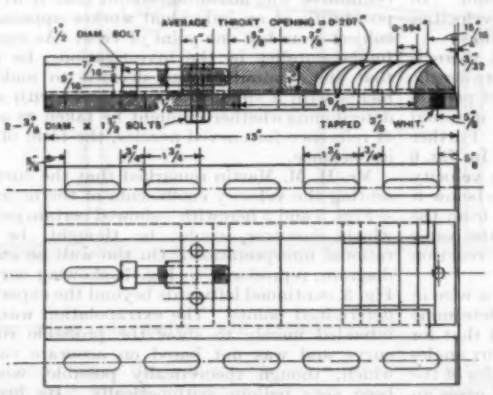
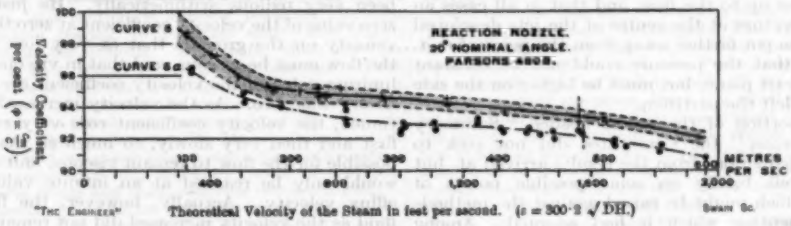


FIG. 4.
Reaction Nozzle-Box.
Parsons 480 B Blades.

FIG. 5.

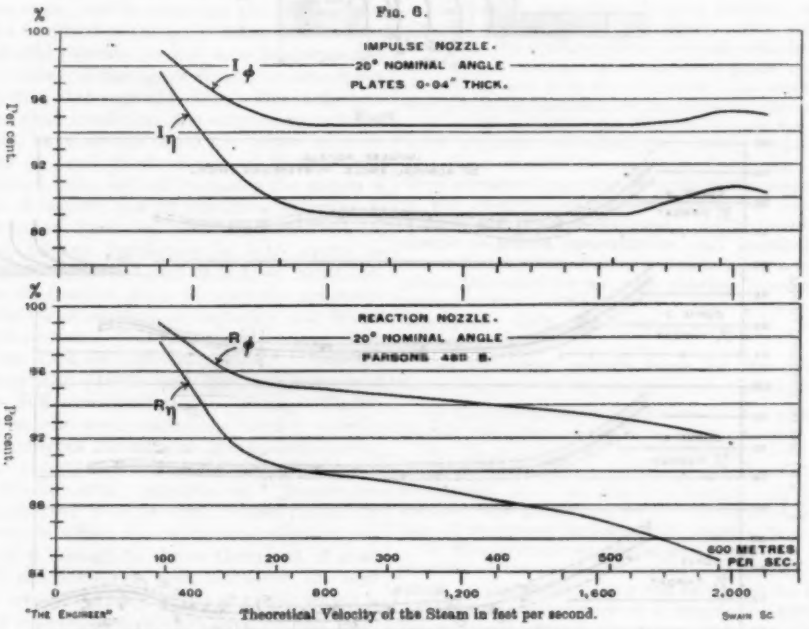


out for the purpose of checking and adjusting the apparatus, experiments were conducted with the object of determining the efficiency of two types of nozzle, namely, (*a*) a thin plate, 20 deg. nominal angle impulse nozzle, and (*b*) the Parsons standard 480 B reaction blading.

Impulse Nozzles.—The form of impulse nozzle tested is illustrated in Fig. 2. The partition plates, it will be noticed, are only 0.04in. thick, while the length of the parallel portion of the throat is three times as great as the throat opening. The values of the velocity coefficient plotted against the theoretical velocity are shown in curve 1 of Fig. 3. The parallel portion of the throat was then reduced successively to $\frac{1}{2}$in., $\frac{1}{4}$in., and finally zero, with the results shown in curves 2, 3, and 4 in the same figure. It is believed that the results are accurate to ± 1.0 per cent. at low velocities, ± 0.5 per cent. at medium, and ± 0.4 at high. These ranges are indicated by the shaded areas in Fig. 2, and it will be seen that all the experimental points, including the check points marked C, fall within these areas.

Reaction Nozzles.—Parsons blading of the type specified was clamped with its own distance pieces in a nozzle box as shown in Fig. 4, the whole being fixed in the tester at a distance from the impulse plate comparable with that adopted in the previous tests. The curve given in Fig. 5 illustrates the results obtained. The chain-dotted curve shows the results obtained in a previous test of the same blading with

FIG. 6.



a different setting, and confirms the general form of the other, although it is not comparable with the impulse nozzle curves. The shaded area in Fig. 5 again represents the probable error.

In order to prevent the impulse readings from being influenced by the weight of moisture condensing on the impulse plate and the cage, the steam used in all tests was superheated. Consequently the critical velocity differs from the value, 1480ft. per second, commonly assigned to dry saturated steam. In Figs. 3 and 5 the points at which the critical velocities occur are marked by short vertical dotted lines.

The curves given in Fig. 3 indicate that there is little to choose between a parallel portion twice the length of the throat opening and no parallel portion at all. If the ratio is greater than 2 to 1 it would seem that the efficiency is affected adversely. Further evidence on this point is now being sought. In Fig. 6 the curve marked I ϕ is the mean of the velocity coefficient curves 2, 3, and 4 in Fig. 3, while below it the curve I η gives the efficiencies deduced from the formula $\eta = \phi^2$. The lower portion of the same figure gives corresponding curves for the reaction blading.

By means of a shaped vane suspended by a wire in the jets leaving the nozzles it was sought to determine the efflux angle of the steam. It was found that for the nozzles illustrated in Figs. 2 and 4 the efflux angles were practically equal to the geometrical angles of the nozzles close up to the face, and that in all cases an inward curvature at the centre of the jets developed as the steam got farther away from the point of exit, indicating that the pressure could not be constant across the exit plane, but must be higher on the side which first left the partition.

In the portion of the report headed "Summary and Conclusion" the Committee did not seek to draw any deductions from the results arrived at, but merely dwelt briefly on some possible points of criticism which might be raised against the methods of experimenting which it had adopted. Among these points are the use of the impulse plate at a distance as great at times as 2$\frac{1}{2}$in. from the nozzle exit, the employment of superheat on both sides of the nozzles, the variation in the initial superheat and the method of calculating the heat drop, a method involving the determination of a small quantity as the difference between two large quantities.

The discussion which ensued upon the presentation of the paper was remarkable for the fact that all who took part in it were members of or were directly connected with the Research Committee itself—except for two members of the American Society of Mechanical Engineers, Messrs. Davis and Herbert, who, though listened to with great pleasure, contributed little to the technical side of the matter.

Professor A. L. Mellanby expressed his fear that the report would be found somewhat disappointing, in so far as it contained little information which would be of assistance to turbine designers. No opinions on the results obtained were expressed and no deductions from them were drawn, because the report was the work of a Committee each member of which held his own views on the lessons of the facts and figures established by the research. This situation was an illustration of a weakness in research work undertaken by a Committee, and would not have arisen had the investigation been placed wholly in the hands of one individual. He urged that the research should be conducted along fundamental lines, as, for example, on straight nozzles rather than on curved blades in order that the precise influence of curvature, at present a largely unknown factor, might be determined. Dr. Mellanby's remarks were subsequently traversed by Mr. I. V. Robinson, one of the representatives on the Committee of the British Electrical and Allied Manufacturers' Association. Mr. Robinson stated that practical turbine designers strongly hoped that the Committee's investigations would be actively prosecuted for a considerable time, as the results being accumulated were proving of very material assistance to them. The draft report was modified by the Committee only editorially; otherwise it was wholly the work of Professor Stoney. He maintained that research by committee was advantageous in that it avoided the possibility of an individual worker approaching the subject from but one point of view. As regarded the fundamentality of the investigations, he intimated that the Committee had decided to make experiments with a simple form of nozzle with a view to determining whether it might be taken as a standard of reference for curved nozzles, the form of practical importance.

Mr. H. M. Martin remarked that the curves representing the velocity coefficients of the nozzles tested—Figs. 3 and 5 herewith—showed certain peculiarities which, however, could, he thought, be given a rational interpretation. On the wall he exhibited a diagram, reproduced in Fig. 7, showing curve No. 4, Fig. 3, continued leftwards beyond the experimentally determined points. The extrapolation was, he said, intended merely to show the probable run of the curve and was not based on accurate calculation, which, though theoretically possible, would have been very tedious arithmetically. He justified the zero value of the velocity coefficient at zero theoretical velocity on the grounds that at very low velocities the flow must be viscous, and that in viscous flow the limiting value of the velocity coefficient according to theory was zero. As the velocity increased, he continued, the velocity coefficient rose very rapidly at first and then very slowly, so much so that were it possible for the flow to remain viscous, unit efficiency would only be reached at an infinite value of the efflux velocity. Actually, however, the flow of a fluid as the velocity increased did not remain viscous indefinitely. At some definite velocity, the value of which depended upon the form and proportions of the nozzle or blading, turbulence appeared near the outlet, and, as the velocity rose still further, this turbulence passed more and more into the blading. In turbulent flow surface friction was higher than in viscous flow. Hence, as the turbulence passed further into the blading the loss resulting from the augmented friction increasingly offset the gain in the velocity coefficient accompanying viscous flow as the velocity rose. It followed, therefore, that for every nozzle there was some definite point at which the efficiency was a maximum, as was brought out in the diagram. From that point onwards the efficiency fell until the flow ceased to be mixed and became wholly turbulent. Continuing to trace out the genesis of the curve, he remarked that in turbulent flow, as was well known, the frictional losses did not in general increase quite so fast as the square of the velocity. Hence, once the flow was turbulent throughout the nozzle, an increase in the velocity coefficient was to be expected. Such

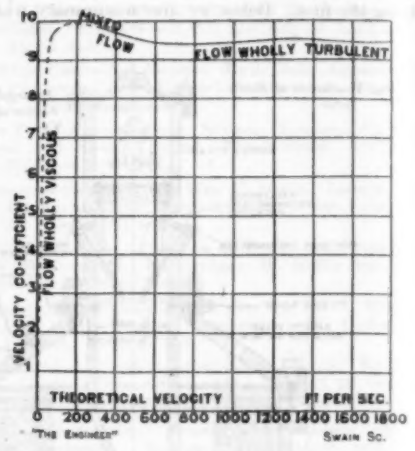


FIG. 7

an increase was shown in the diagram. Still later the curve showed a slight decrease. This diminution, he believed, was produced by the approach of the *vena contracta* to the outlet as the velocity increased, and by a consequential decrease in that proportion of the total final momentum of the jet which was produced after the jet was clear of the solid surfaces of the nozzle outlet and of the friction of the walls thereof. He believed that the form of the curve obtained with the Parsons blading could be explained in a similar manner. Dealing with the portions of the curves covering velocities in excess of the velocity of sound, he pointed out that in such circumstances the jet was delivered from the nozzle at a pressure in excess of that in the discharge box. As a consequence stationary waves would be formed in the jet, and the force registered by the impulse plate of the testing apparatus would depend for its exact value on whether the position of the plate corresponded with a node or a loop in the wave.

Mr. Telford Petrie, the superintendent of the research, dealt with a phenomena known as the "flapping" of the jet, which was discovered in the early stages of the investigation. It appears that, at first, trial tests with Parsons nozzles showed that after all adjustments and refinements had been made, the influence of some disturbing factor, which was affecting the consistency of the results, was noted. The source of the trouble was ultimately traced to the presence on the nozzle box of a flat surface about 2in. long below the lowest nozzle opening—see Fig. 1. The effect of this surface was to cause the jet to impinge on the impulse plate about 2in. out of centre and to make it "flap," more particularly at low-pressure drops. The end of the box was therefore chamfered, as shown in Fig. 4, so as to leave no obstruction below the last nozzle other than the thickness of the blade. In the course of his remarks, Mr. Petrie made it clear that the trouble was not caused solely by the external form of the box, but was in part contributed to by the existence of a small pocket at the lower end of the inside of the box.

Mr. Martin also referred to the subject, and said that the discovery of the phenomenon of "flapping" was obviously of great importance, for it had a very direct bearing on turbine design. It seemed, he remarked, to indicate the desirability of making the partition plates for impulse nozzles end in knife edges.

Professor Stoney, in his preliminary and final remarks, explained that the nozzles so far examined were not of special design, but were such as were used in current practice. The 1in. Parsons blading tested was of a standard form, while the impulse nozzles were made by the British Thomson-Houston Company with the division plates cast into the iron, and were identical with the form commonly used in impulse turbines. Impulse nozzles of 20 deg. angle with division plates $^{3}/_{16}$in. thick, and thin and thick plate impulse nozzles of 12 deg. angle, as well as $\frac{1}{2}$in. Parsons blading, were now being tested. He had no doubt that Mr. Martin's explanation of the form of the velocity coefficient curve was correct. In fact, that explanation was confirmed by some results recently obtained by Mr. Dempster Smith and Mr. W. J. Walker in an investigation into the flow of water through orifices, an account of which was to be

found in the first part of the Institution's "Proceedings" for 1923.

AN EDUCATIONAL GRANT.

Mr. William Henry Allen, past-vice-president, has presented to the Institution of Mechanical Engineers the sum of £1000, and has desired the Council to select a suitable student or graduate to receive this grant, in three instalments, at Trinity College, Cambridge. Applications for the grant are invited from students and graduates of the Institution under the following general conditions. Applicants should preferably be between twenty and twenty-five years of age. They must not be already possessed of a university degree, but must be able to satisfy the Council that they possess such educational qualifications as will ensure that they would derive the maximum possible benefit from an honours course in engineering (Mechanical Science Tripos) at Cambridge. Preference will be given to an applicant who has had some practical workshop training.

Applicants must be prepared to go into residence at Cambridge in October, 1923, to pass, unless exempt, the Cambridge University Previous Examination ("Little Go") not later than that date, and to read for the B.A. Degree in Engineering (Honours). The selected applicant will be entitled to continue to receive the grant so long only as he satisfies the Council of Trinity College as to his conduct, diligence, and progress in his studies. Applications should be made on a form to be obtained from the secretary, and must be received at the Institution not later than May 1st, 1923.

An Automatic Stone Drying and Tarring Plant.

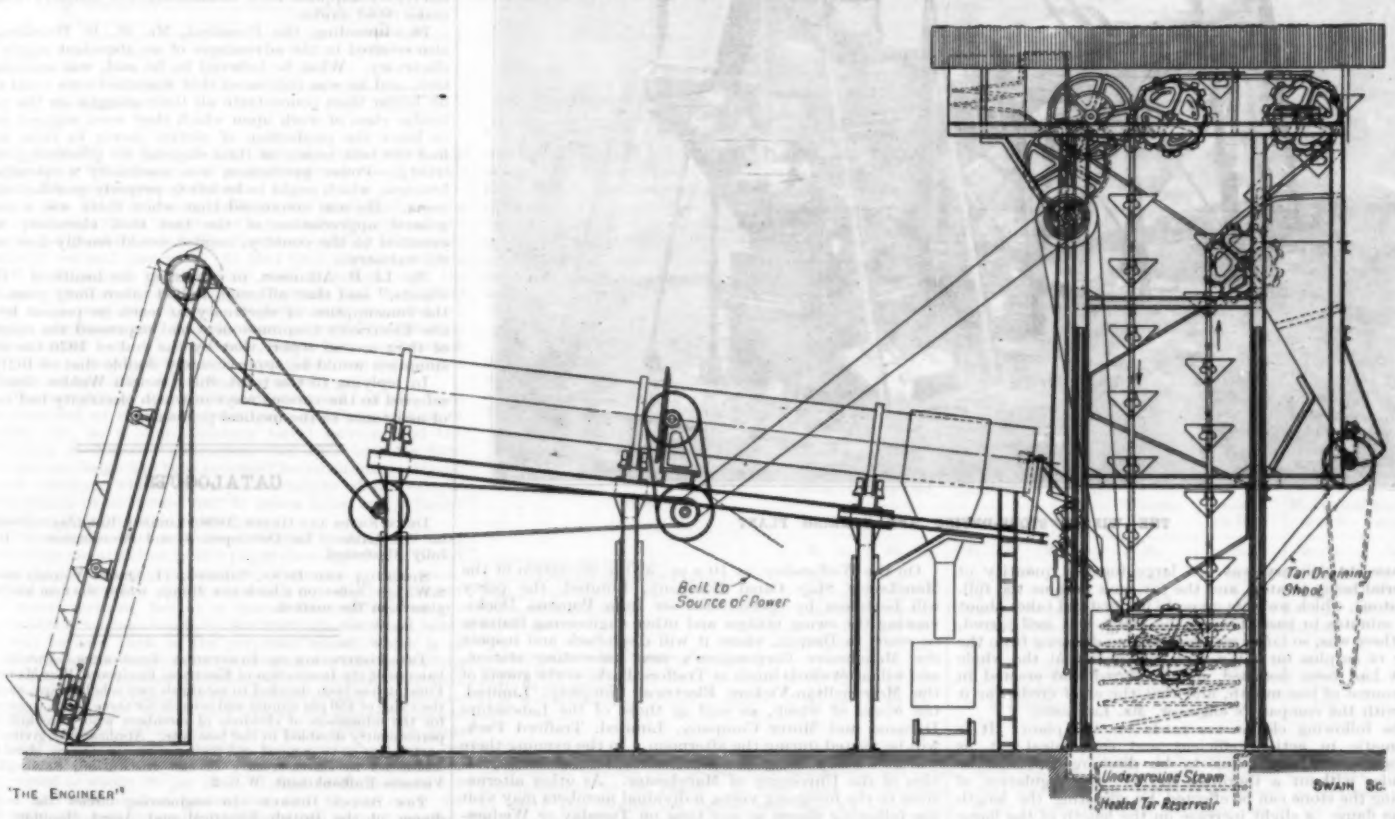
ON Wednesday of last week a party of county and borough engineers and others interested in road construction and maintenance were invited by Winget, Limited, to witness at its works at Warwick a demonstration of the operation of a new stone-drying and tarring plant which it has just designed and constructed. The plant is intended for an output of 100 tons of tarmacadam per day of eight hours and, though it is the first of its type and has been constructed with remarkable celerity, the company is evidently so satisfied that it has evolved a design which will not require radical alteration, that it has not only put in its lists, but actually quoted prices for, plants of three other sizes with outputs of 20, 50 and 200 tons per day, respectively.

The apparatus is illustrated in the accompanying engravings. Briefly described, it has at one end a power-driven bucket conveyor which raises the broken stone and delivers it through a chute into the upper end of an inclined steel cylinder which is continuously revolved, and into the lower end of which is inserted the nozzle of an oil burner. The stone, as it traverses the cylinder, is thoroughly dried by the heat produced by the flame from the burner, and just before it is discharged it passes over a portion of the cylinder which is perforated with numerous holes, through which any dust there may be passes away, while the larger particles continue their journey. Round the perforated portion of the cylinder there is a hood with a spout depending from it, and by way of the latter the dust falls into a wheeled truck, which may be taken away and emptied at intervals. The delivery from the drying cylinder is into a chute, the lower end of which is closed and opened automatically at regular intervals. Arranged in a tower built up of rolled steel joists is an endless chain of buckets or stone containers slung on pivots between flexible steel links, and made to pass over four pairs of specially shaped sprocket wheels, the arrangement of which may be seen in the drawing. The direction taken by the row of containers nearest the drying cylinder, when the chain is put in motion, as will be presently explained, is vertically downwards, and matters are so arranged that the chain is automatically moved forward in steps, each step being of such height that container after container is in turn brought into the correct position to receive the stone discharged from the chute. The movement is timed to correspond with the opening and closing of the discharge controlling door of the chute, so that the discharge of stone is stopped before the full container is moved downwards another step, and while the container next above it is brought into position to receive its charge of stone. The charged containers are in turn passed down into and up from a tank of hot tar, and are then gradually raised until, just after passing over the first guiding sprocket, they are tripped so that their contents is discharged into a hopper of large capacity, the delivery chute of which can be opened or closed by means of a chain-operated wheel, which is worked by hand. This delaying of the discharge of the tar-macadam is for the purpose of allowing all the surplus tar which can drain away from the stone to do so, the drainings finding their way down a steel plate chute back into the tar tank.

The foregoing is, in brief outline, a description of the plant and the way it works, but it leaves a lot still to be told, for several very ingenious contrivances have been worked into the complete machine. The motive power can be of any type, but as we saw it the plant was operated by a small steam traction engine, and undoubtedly steam is the most useful medium to employ, since heat is necessary for several purposes, and some means are required for working the oil burner. The drive from the traction engine was on to a countershaft suspended from the joists on which are arranged the bearing rollers for the drying cylinder, which will be referred to later. From the countershaft just mentioned, all the motions of the plant are operated. First of all by means of two chain belts and different sized pulleys and pinions a slow speed is imparted to the conveyor which lifts the raw stone. Then by means of another chain belt, a bevel pinion and a bevel wheel, which embraces the drying cylinder, motion is given to the latter. In the drawing the bevel pinion is shown as coming at the right-hand side of the bevel wheel. As actually constructed it is on the left-hand side, and against the plain face of the wheel there is a bearing roller, the spindle of which is at right angles to the axis of the drying cylinder. From the countershaft, too, a leather belt is taken up to another countershaft near the top of the tower, and motion is thereby imparted, through spur-reduction gearing, to a further shaft—that shown uppermost in the drawing. This shaft, which revolves at quite a slow speed, performs two functions. First of all by means of a cam working in conjunction with a weighted lever, it actuates the mechanism of the chute, down which the dried stone coming from the dryer is delivered to the containers. By the combined action of the cam and weighted lever a vertically reciprocating motion is given to a rod, which, by means of a system of bell crank levers and links, performs two operations:—(*a*) It alternately advances and withdraws the delivery chute in such a way that first of all its end is just over the top of a container so that the stone falls directly from it into the latter, and then, when the desired quantity of stone has been delivered, pulls the chute back so as to leave a free path for the travel of the chain of containers; and (*b*) it raises and lowers a hinged flap or door so as in the first case to allow stone to pass down the chute, and in the second case to prevent it from doing so. It will be clear, therefore, that no stone is allowed to issue from the chute unless the latter is in such a position that all the material must fall into a container. The carriage supporting the reciprocating chute is mounted on rollers so as to reduce friction, and its action is assisted by means of counterweights and ropes.

Keyed on the same shaft as the cam, and revolving in unison with it is a gear wheel, only a small portion of the periphery of which is furnished with teeth, so that only for a fraction of its revolution is it in mesh with a spur wheel, which is keyed on the shaft that carries the driving sprocket wheels of the chain of containers. By this means the containers, instead of being made to travel continuously, are moved only a step at a time, the steps being just long enough to permit of each container being brought in turn exactly into the correct position to receive stone from the chute coming from the drying cylinder. The motions of chute and containers are, of course, made to synchronise exactly, since the cam and the "hit and miss" gear wheel are on the same shaft, and no stone is allowed to fall anywhere but into the containers.

The containers are V-shaped, and though it was impossible to see their construction, because of their being coated with tar, we were informed that they were made up of woven metal stretched on a framework, the mesh, of course, being sufficiently small to prevent the stone falling through the interstices but large enough to permit of the free circulation of the tar, as container after container is immersed in a square tank of tar arranged at the foot of the tower. The tar in the tank is kept in a fluid condition by the circulation of steam through pipes arranged in its interior. Saving at one point in their travel the containers always hang with their V point downward. As they are hauled up from the tank there is, naturally, a considerable quantity of surplus tar which drains away. So that the drawings from one container may not fall on the container immediately below it, each container is provided at its bottom with a V-shaped freely-hanging trough, which is arranged on an incline, so that the tar can flow down it, and projects sufficiently far beyond the end of the container for the tar discharged from it to fall directly into the tank and clear of the containers below it. Just after the containers in turn have passed over the sprocket wheels where their direction is changed so as to bring them immediately above the discharge hopper, they meet a tripper which tilts them through a right angle and discharges their contents into the hopper. Having passed the tripper the containers immediately return by gravity to their normal condition and hang vertically. In the hopper the tarred-stone is detained for a short period, as explained above, for all the free tar to drain away.



AUTOMATIC PLANT FOR DRYING AND TARRING STONE

In the plant which we saw in operation there was an underground reservoir of tar, the top of which was at ground level, so that barrels could be readily rolled up to it and their contents discharged. This reservoir, like the tank immediately above it, was furnished with steam pipes so as to keep the tar fluid. For raising the tar from the reservoir into the tank to make up for the material used for coating the stone, there is a small pump driven by belt from the first motion countershaft at the top of the tower. As we actually saw the apparatus in operation the tower was open, but in practice it will be enclosed and, so as to keep fluid the tar in the interstices of the container screens, and also that which must find its way into the chain joints—and thus reduce friction—the interior will be kept warm by the circulation of steam through the pipes to be seen in the drawing. These pipes, we may say, were, in the plant shown at Warwick, in series with a coil of piping arranged in the interior of a tank, fixed at the top of the tower, which contained crude oil for use in the heating burner, the atomisation and pro-

pulsion through the nozzle of the burner being also effected by steam.

The cylinder in the 100-ton plant which we saw is 30ft. long by 2ft. 6in. in diameter. It is built up of curved steel plate riveted together. We were informed that no lining whatever is employed, the internal temperature—though evidently quite sufficient to dry the stone which, by the way, was, in its untreated state, exceedingly wet, heavy rain having fallen quite recently prior to the demonstration—not being high enough to render it necessary. A series of angles is arranged inside the tube which lift the stone and let it fall through the path of the heated gases, thus assisting in the work of drying it. The cylinder is furnished at three points with steel bearing rings, which do not bed on the cylinder itself, but are separated from it by distance blocks. These rings rest and revolve on flanged rollers which are carried by brackets attached to the steel joist framing. The flanged rollers, of course, prevent endwise movement of the cylinder.

The plant as we saw it at work was operating excellently, treating first of all fine stone and afterwards larger material. Fifteen horse-power were, we were informed, required to drive it. A couple of men were employed in feeding the stone to the conveyor, while a third looked after the discharge of the finished product into a motor lorry. There was also a man in charge of the traction engine which provided the power and steam for heating, &c. As far as we saw, the burner in the drying cylinder required no attention, and only once did we observe the tar pump being looked to, and that was

THE WINGET STONE-DRYING AND TARRING PLANT

because its delivery was too large for the quantity of material being treated, and the tar tank became too full. The stone, which we were given to understand takes about four minutes to pass through the plant, was well tarred, and there was, so far as we observed, no dripping from the lorry of surplus tar. We were informed that the whole plant had been designed, manufactured and erected in the course of one month, and that the chief credit for it lay with the company's engineer, Mr. Lancaster

The following claims are made for the plant. It is automatic in action, efficient and economical; it is impossible for any stone to be discharged from the cylinder without a thorough drying; the regulation of heating the stone can be effected by adjusting the length of the flame—a slight increase on the length of the flame during wet weather compensating for the increase of moisture, the output being unaffected; when a container enters the tar bath, the tar surges up through the stone, slightly buoying it up, and thoroughly saturating every particle in the container; the size of stone in no way affects the method of treatment; the speed of the machine can be regulated should the temperature of the tar have been allowed to fall too low during manufacture; regulation of the dipping-time works in sequence with the draining-time, so that when the temperature is low and the viscosity high, the dipping-time is extended together with the draining-time, thus compensating for the increased amount of tar in the container when it leaves the surface of the bath; by raising the temperature the tar taken up by the stone can be decreased to 5 gallons per ton, and by lowering the temperature the tar content can be increased to 11 gallons per ton. By paying due attention to the temperature, 7 gallons per ton can be maintained throughout a day's work; the machine is semi-portable and easy to erect owing to the lightness of the structural details.

Institution of Electrical Engineers—Summer Meeting.

The Summer Meeting of the Institution of Electrical Engineers will, at the invitation of the Committee of the North-Western Centre (Mr. A. S. Barnard, chairman), with the co-operation of the Committee of the newly formed Mersey and North Wales (Liverpool) Centre, be held at the North-Western Centre from June 5th to 8th next. Ladies are invited to take part in the meeting. The following programme has been arranged:—

Tuesday, June 5th, in the morning at 10 a.m., there will be alternative visits to (*a*) the electrically driven rolling mill equipment of R. Johnson and Nephew, Limited, Bradford, Manchester, and the engineering works of Mather and Platt, Limited, Newton Heath; and (*b*) the No. 2 Dunlop Rubber Cotton Mills, Limited, Rochdale. The visitors will lunch at the Manchester Town Hall as the guests of the Corporation Electricity and Tramways Committees. In the afternoon the party will proceed to Clifton Junction, the works there open for inspection being those of (*c*) the Pilkington Tile and Pottery Company, Limited; (*d*) the Chloride Electrical Storage Company, Limited; (*e*) the London, Midland and Scottish Railway Company's power station; and, at Ringley, (*f*) the Lancashire Electric Power Company's station. In the evening there will be a reception and dance at the Town Hall, at the invitation of the Lord Mayor and Corporation of Manchester.

On the Wednesday, at 10 a.m., at the invitation of the Manchester Ship Canal Company, Limited, the party will be taken by special steamer from Pomona Docks, viewing the swing bridges and other engineering features *en route*, to Barton, where it will disembark and inspect the Manchester Corporation's new generating station, and will afterwards lunch at Trafford Park, as the guests of the Metropolitan-Vickers Electrical Company, Limited, the works of which, as well as those of the Lancashire Dynamo and Motor Company, Limited, Trafford Park, will be visited during the afternoon. In the evening there will be a reception at the Whitworth Hall, at the invitation of the University of Manchester. As other alternatives to the foregoing visits, individual members may visit the following places at any time on Tuesday or Wednesday:—(1) The outdoor 33,000-volt sub-station, in High-street, of the Manchester Corporation; and (2) the *Manchester Guardian* offices for the Murray multiplex system of telegraphy and rotary printing presses; and, (3) on Wednesday morning only, the laboratories of the University, Manchester, will be open for inspection.

On the Thursday, June 7th, at 9 a.m., the party will leave Manchester by special train for Liverpool (detraining at Rainhill for the Prescot visit). There will be alternative visits to (*a*) the British Insulated and Helsby Cable Works, Prescot; (*b*) (1) the Liverpool Corporation tramways, Lambeth-road works, (2) automatic sub-station, Walton, and (3) Lister Drive power station; and (*c*) the Cunard Company's ss. Scythia, or some other big liner. In the afternoon there will be alternative visits to (*d*) the works of Messrs. Lever Brothers, Port Sunlight (by train from Liverpool); (*e*) the University applied electricity laboratories, where demonstrations in radio reception will be given, and the works of the Automatic Telephone Manufacturing Company, Limited; (*f*) if there are sufficient applicants, alternative visits will also be paid to (1) the Liverpool Corporation tramways, Lambeth-road works, (2) the automatic sub-station at Walton, and (3) the Lister Drive power station. As other alternatives to the foregoing afternoon visits, individual members may also visit (*g*) the Mersey Power Company, Runcorn; (*h*) the United Alkali Company's power station, Widnes; (*i*) the London, Midland and Scottish Railway, Southport electrified line. In the evening there will be a reception and dance as the guests of the Lord Mayor of Liverpool.

On the Friday, at 9 a.m., the party will leave Liverpool by special train for Llandudno Junction, where it will transfer to motor coaches and proceed by alternative routes, as follows:—(*a*) *Vid* the Conway Valley, Bettws-y-Coed, Capel Curig, Llanberis or Nant Ffrancon Pass to Carnarvon and Bangor, returning along the coast road to Llandudno; a halt will be made at Dolgarrog to inspect the hydro-electric power station and works of the Aluminium Corporation, Limited; (*b*) generally as (*a*) above, but the halt will be made at Pen-y-Gwryd to inspect the North Wales Power Company's hydro-electric station at Cwm Dyli; (*c*) generally as (*a*) above, but the halt will be made at Lord Penrhyn's slate quarries, Bethesda. In the evening there will be a reception and dance at the Grand Hotel, Llandudno, as the guests of the London, Midland and Scottish Railway Company, Limited. The guests will be received by Mr. A. Watson, the general manager of the company.

Electrical Development Association.

At the annual luncheon of the British Electrical Development Association, which was held at the Hotel Cecil on Friday, March 16th, a large and distinguished body of engineers and others assembled. The principal guest was Viscount Haldane, who, in proposing the toast of "The Electrical Industry," referred to the value of scientific knowledge and research and the importance of a proper understanding on the part of the public of the immense service electricity could render to the country. It was very essential, he said, that the electrical industry should keep in touch with the universities, which were the guardians of their knowledge. It was the mind that created wealth and not labour. Unfortunately, the advantages of electric power were very improperly understood. Five years ago the Coal Conservation Committee, of which he was chairman, arrived at the conclusion that the industries of this country could be run with 25,000,000 tons of coal per year instead of 80,000,000 tons, which they were using. As soon as the manufacturing world realised that it could be supplied with electrical power at a very much lower cost than that which old and wasteful methods involved, and as soon as workmen appreciated how much their position would be improved if large electricity supplies were established, the industry would make rapid strides.

In responding, the President, Mr. W. B. Woodhouse, also referred to the advantages of an abundant supply of electricity. What he believed in, he said, was specialisation, and he was convinced that manufacturers could not do better than concentrate all their energies on the particular class of work upon which they were engaged, and to leave the production of motive power to those who had the best means at their disposal for generating electricity. Power production was essentially a specialised business, which ought to be left to properly qualified engineers. He was convinced that when there was a more general appreciation of the fact that electricity was essential to the country, capital would readily flow into the industry.

Mr. Ll. B. Atkinson, in proposing the health of "Our Guests," said that although it had taken forty years for the consumption of electricity to reach its present level, the Electricity Commissioners had expressed the opinion of their second report that by the end of 1926 the consumption would be approximately double that of 1921.

In replying to the toast, Sir Kenneth Weldon Goadby referred to the various ways in which electricity had been of assistance to the medical profession.

CATALOGUES.

Dean, Smith and Grace (1908), Limited, Keighley.—Booklet on "A Lathe: Its Development and Manufacture." It is fully illustrated.

Stockton and Bunn, Limited, 11, Queen Victoria-street, S.W. 1.—Leaflet on a hack saw frame, which the firm has just placed on the market.

The Institution of Electrical Engineers.—Out of the balance of the Institution of Electrical Engineers' War Memorial Fund it has been decided to establish two scholarships, each of the value of £50 per annum and tenable for three years, to provide for the education of children of members who were killed or permanently disabled in the late war. Applications, giving full particulars as to general and financial circumstances, should be addressed to the secretary of the Institution, Savoy-place, Victoria Embankment, W.C. 2.

The Beama Dinner.—In engineering circles the annual dinner of the British Electrical and Allied Manufacturers' Association, popularly known as "The Beama," has come to be regarded as one of the most important social gatherings of the year. There are certainly few functions in the same category which are capable of drawing together such a crowd of engineers from all parts of the kingdom, and the promotors are to be congratulated upon the success which attends this great annual reunion. What will happen in the near future if the attendance continues to increase as it has done in the past we are at a loss to prophesy. Certainly, few hotels, even in London, will be able to accommodate such huge gatherings. The attendance at the dinner held on Thursday, 15th inst., in the Edward VII. Rooms, at the Hotel Victoria exceeded 500. The Earl of Derby, President of the Association, was in the chair. In proposing the toast of "The President," Mr. B. Longbottom took occasion to refer to the manner in which the voice of industry was becoming audible in the councils of the nation. Lord Derby, in replying, said that the only way in which those who, from chances of fortune, were put into a position such as his could justify their existence was by doing their best to help trade and industry, and he concluded by reading a message from the Prince of Wales accepting the invitation of the Council to dine with them on November 15th next. Sir James Stevenson proposed the toast of "The Industry," to which Mr. P. J. Pybus relied; while the toast of "The Guests" was responded to by Sir Joseph Cook and Sir Richard Glazebrook.

A Proposed Aircraft Carrying Mail Steamer.*

By Sir EUSTACE D'EYNCOURT and JOHN H. NARBETH.

IN describing "Naval Construction during the War," before this Institution in 1919, some reference was made to the production of aircraft carriers for naval purposes, and it was stated, "There is no question that aircraft carrying will gradually become more important for the Fleet." The few years which have since elapsed have fully confirmed that opinion, and the value of the aircraft carrier for naval purposes is indicated by the large sum of money voted in the current Navy Estimates for that class of work.

The experience gained in the naval aircraft carriers indicates that flying on to, and off from, ships at sea is rapidly becoming thoroughly practicable. Some six hundred successful flights on to H.M. ships Argus and Eagle have already been made, under varying conditions of weather, at sea.

It may well be that we are now advancing to a position in which the aircraft carrier will become relatively quite as important a ship for the mercantile marine, and that with the growth of opinion and technique, shipowners will presently be prepared to face the bills which will arise from the adoption of a new type of vessel of this class, for commercial purposes.

At the Air Conference held at the Guildhall in the autumn of 1920 a suggestion was made by one of the principal speakers to consider the practicability of carrying aircraft on mail steamers. At that time some experience had been gained in fitting up mail steamers, *e.g.*, the Australian Government steamer Nairana had been fitted out as a seaplane carrier. Stowage was provided for seven seaplanes, and derricks were provided for hoisting them in and out. This, however, was a very cumbersome method and totally different in conception from the aircraft carrier as specially developed for naval purposes.

The carrying of aircraft in mail steamers had also been approached at that time from quite a different point of view, viz., as a supplementary naval service, and the Director of Naval Construction was able to state that an outline design had been prepared for an aircraft-carrying mail steamer, which could accommodate about twenty aeroplanes of moderate size, in peace time, and a larger number, if required, in case of war.

The question has now been further investigated, and drawings are attached to this paper showing what is hoped may be the basis for a practical discussion on the possibility of an aircraft carrier regarded, not as a supplement to naval services, but as a special development of the mercantile marine; and, by the methods described later, it will be seen that, in the proposed vessel, which is of quite moderate dimensions as compared with the leading Atlantic liners, besides providing all the facilities required to complete the vessel as a commercial, mobile aerodrome, there will remain ample deck spaces for accommodation of all kinds and particularly an enormous open upper deck available for recreation, besides large protected areas on the next deck beneath it. The cabin accommodation provided is about 80 per cent. of that of Mauretania for first and second-class passengers, and 40 per cent. for third-class passengers, although the vessel is much smaller, and large spaces are set apart for aircraft. It is hoped that the proposals will be found worthy of the careful attention, not only of the members of this Institution, but of the ship-owning interests of this country.

The combination of nautical and aeronautical craft for a common purpose is by no means an unreasonable proposition; their relations deserve careful study, as will now be shown.

The idea of the aeroplane serving as handmaid of the merchant ship is already in vogue to a limited extent. In case of need, passengers now occasionally leave London or Paris by aeroplane some time after the hour when the mail trains leave. The aeroplanes get to an aerodrome at the port in time to enable the passenger to alight and then embark on the liner with which the mail train connects, thus giving a very notable advantage in time saved to the traveller. The advantage will obviously be increased if the aeroplane, instead of alighting at an aerodrome and requiring the passenger then to proceed by some other conveyance to the ship, possibly by motor car and also by ferry steamer, could also fly right on to the ship herself while she is proceeding on her voyage at sea. Should this be practicable, flying on and off ships at sea opens up a great vista of future developments for combined air and steamer services.

Before mentioning the possibilities of some of these future developments, it is perhaps well to consider the practicability of building mail steamers in such a way as to offer the facilities necessary for accommodation of aircraft and at the same time for the accommodation of passengers, mails, and cargo, so that the whole combination might be run as a commercial concern. This proposal is put forward entirely as a commercial proposition and not as a subsidiary naval vessel. This point is mentioned at this stage because the proposal embodies a machinery arrangement based on naval designs, but that is the only part of the vessel which can be regarded as in any sense related to the Navy. It is fully recognised that the nearer the vessel can approach to ordinary commercial purposes the better, and it is hoped that in the discussion which will take place on the paper that this aspect will be thoroughly discussed and criticised with the greatest freedom.

The vessel proposed as a basis for this discussion is 600ft. long between perpendiculars with a beam at the water line of 80ft., a mean draught of 28ft., and a displacement of about 24,000 tons when leaving port fully laden with about 2500 tons of fuel and 1500 tons of cargo. Water-tube boilers are provided for, capable of generating steam for about 50,000 horse-power; together with geared turbines and twin screws absorbing 40,000 to 45,000 horse-power, and giving a speed of 24 knots on trial at a mean draught of 26ft. The arrangements proposed, with steam-driven propelling machinery, involve the great drawbacks incidental to large funnels and uptakes, but the general design of the vessel would remain if it were possible to fit her with internal combustion engines of the requisite capacity. The suggestion to build aircraft carriers with Diesel engines for propelling machinery has often been made, but up to the present date no engines of the required capacity have been produced. The largest yet ordered for liners are only about half the power required for this vessel.

DECK ACCOMMODATION.

The flight, or "A" deck, p. 324, is approximately rectangular, being 565ft. long and 100ft. wide throughout, and it is entirely free from all obstructions. The deck finishes off practically square at a position 100ft. from the bow. The tapering end of the deck forward, which has been omitted, would appear to serve but little purpose, whilst its omission enables very satisfactory navigating and cable arrangements to be made. A fore mast is proposed, to carry the navigation lights, and also to carry long derricks for hoisting of cargo, aircraft, stores, baggage, &c., to the flight deck, and thence to the holds. The mast arrangement may appear at first sight open to objection as being in the way of aircraft, but this view is not sound, for machines rise in a very few yards, and after a very short time are well in the air and can be manœuvred to either side of mast and shrouds, without any trouble; while for landing there is a flight deck 565ft. long, and in case of failure to alight the machine would get away clear of the vessel long before reaching the mast position over the bow.

An alternative scheme has been prepared—Fig. 4—showing what would be involved if the fixed mast is not adopted, substituting therefor close stowing cranes for handling cargo, aircraft, &c., and a telescopic mast for carrying the steaming and navigating lights.

The second, or "B" deck, is more or less open fore and aft to permit of some flow of air along the underside of the flight deck, assisting to give a uniform flow of air above the flight deck. At the forward end is situated the navigating bridge, which is about 35ft. above water and well protected from the weather. On each wing of the bridge is a look-out tower for sighting aft, working the docking telegraphs, &c. Abaft the officers' quarters is a block of lifeboats, twelve in number, which can be launched from either side, and abaft this is the lift serving the forward hangar, while the space around the lift opening forms an aircraft assembling space. Flaps are arranged abreast the lift, in the flight deck. When these are lowered, they provide wind protection for the purpose of rigging the machine, and the openings enable the spread machine to go to the flight deck ready for flight. The lift machinery is also fitted on this deck. Abaft this lift is the second block of twelve lifeboats arranged as described above, and abaft these lifeboats is the second lift and assembling space arranged as before. Abaft the second lift an emergency oil-driven dynamo is fitted, and behind the dynamo the smoke ducts rise from the boilers and fill in the amidship space aft.

The third, or "C," deck, which runs right to the bow, is the first cabin deck.

The design provides for bulges with a view of obtaining some protection by them against results of damage by icebergs, collision, or other misadventure in peace time, and as a protection against the effects of mines, torpedoes, &c., in war time. They are arranged to carry oil when required for specially long voyages, thus supplementing the oil carried in the double bottoms and wing compartments to practically any desired extent. By making the bulges an integral part of the ship an efficient "form" can be designed in the first place, so that they do not involve loss of speed, or, stated in another way, they do not increase the horse-power required for a fixed speed.

An incidental, but very great, advantage arises from the adoption of the bulge. It enables a very broad vessel to be built without involving excessive initial stability, or undue resistance, and so permits large deck areas to be provided at an economical cost for production, far less, indeed, than if the vessel were of the usual proportions, and had to be increased in length to give the same deck areas. It should be remembered, however, that a very broad flight deck is essential.

Although the addition of the bulge will make the ship very broad beneath the water, and will provide the means for carrying very broad decks above the water, the breadth at the water line itself is not so great, and this will avoid the necessity of giving the ship too much initial stability. The initial stability, as measured by the metacentric height with the ship at rest in the various conditions of lading, will be kept as small as possible in order that the ship may not be a quick roller. The formation of the bulges, with the addition of bilge keels, will provide considerable resistance to rolling. This resistance, taken in conjunction with the small metacentric height, will make the ship very steady at sea, but it is proposed, in addition, should it be found desirable, to make use of the most efficient stabilising devices which may be obtainable when the ship is built.

A steady ship is, of course, of the greatest attraction to passengers, and is most desirable also from the aviation point of view.

TABLE I.

Type.	Dimensions spread. Length.	Span.	Dimensions folded. Length.	Span.	Weight, light.	Load, ex fuel.	Maximum speed.	Endurance (approx.).
	ft. in.	ft. in.	ft. in.	ft. in.	lb.	lb.	m.p.h.	hours.
MILITARY MACHINES—								
Torpedo carrier (Sopwith Cuckoo) ..	28 4	46 8	28 4	16 9	2160	1280	97	3½
Parnall Panther	25 0	29 5	14 6	29 5	1328	726	108	4½
Nieuport Night Hawk	19 6	28 3	10 6	28 3	1552	398	139	1½
Flycatcher	23 1	29 0	Non-folder		1980	509	133	3½
Bison	37 0	46 0	37 0	17 6	3700	1256	108	3
COMMERCIAL MACHINES—								
Bristol ten-seater	41 8	54 3	Non-folder		4427	1788	115	4½
D.H. 34 six-seater	41 3	51 5	Non-folder		4453	1620	111	3½
D.H. 9 C three-seater	30 10	42 5	Non-folder		2456	800	110	5

An incidental to large funnels and uptakes, but the general design of the vessel would remain if it were possible to fit her with internal combustion engines of the requisite capacity. The suggestion to build aircraft carriers with Diesel engines for propelling machinery has often been made, but up to the present date no engines of the required capacity have been produced. The largest yet ordered for liners are only about half the power required for this vessel.

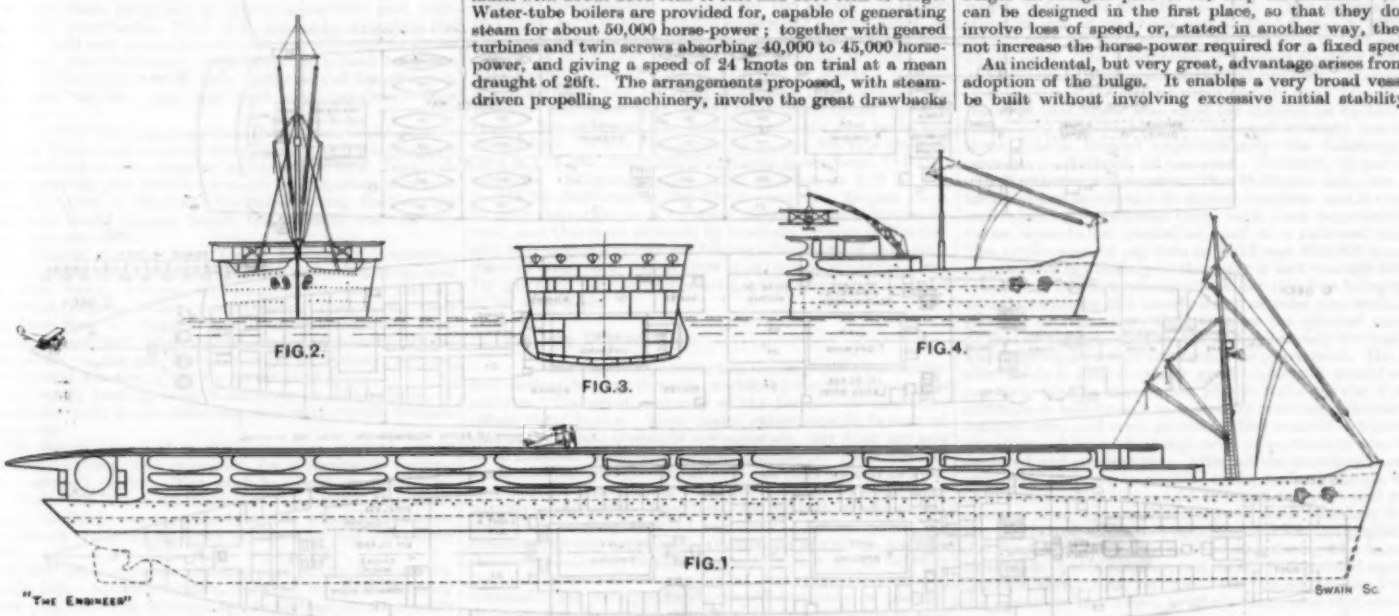
CAPACITY FOR AIRCRAFT.

The capacity for carrying aircraft depends upon the type and construction of the aircraft, as well as their extreme dimensions. It would be necessary to modify existing commercial types by fitting the wings to fold back, or the tails to hinge, in order to be able to adopt lifts of a reasonable size and to stow a good number of machines of sufficient carrying capacity.

In the absence of such types an estimate of capacity for stowing naval types of aircraft has been made with the results shown in Table II.

TABLE II.

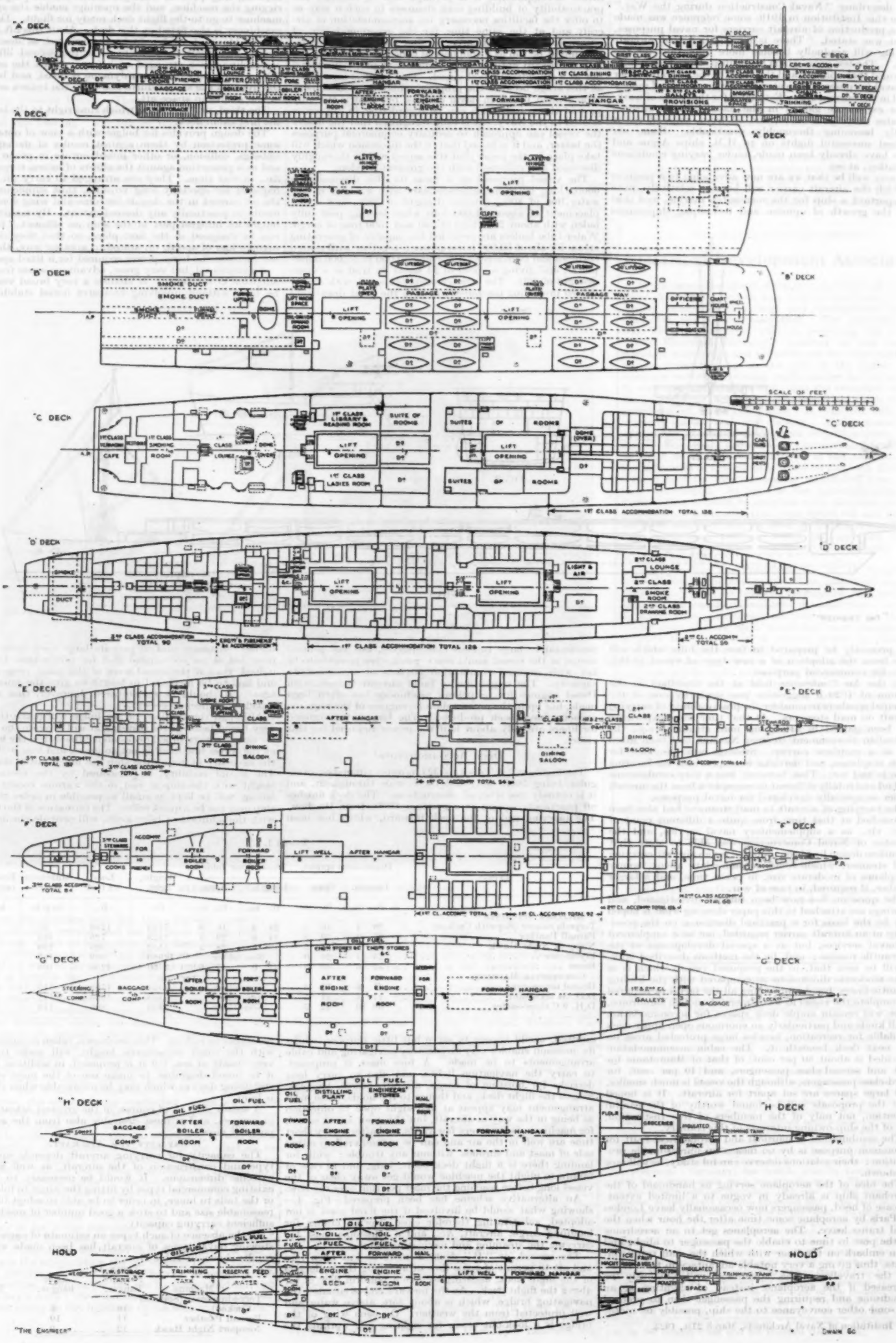
Machine.	Forward hangar.	After hangar.	Total.
Torpedo carrier (Sopwith Cuckoo)	10	8	18
Parnall Panther	11	10	21
Nieuport Night Hawk ..	12	9	21



* Institution of Naval Architects, March 21st, 1923.

PROPOSED AIRCRAFT CARRYING MAIL STEAMER

(For description see page 323)



In making these estimates the machines are assumed to be folded, or stowed closely, but leaving the lifts empty and a clear space for one machine near each lift. The stowages are alternative, *i.e.*, in each case the hangar is completely occupied by one type of machine only, as shown in Column 1. When the demand is small only one hangar need be used, giving room for eight to twelve machines, while if both hangars are used, from eighteen to twenty-two machines of the types named can be taken.

The outside dimensions of the machines taken compare with commercial machines as shown in Table I.

It would probably be found in the course of a short time that "joy rides" from the ship would be very profitable, and small two-seater machines could be provided for such a purpose. By this means on many routes passengers could view towns and country of great interest from the air, without going ashore, or stopping the vessel. On a yachting expedition to Norwegian fiords such a ship with a squad of machines for this purpose would prove a great attraction. In addition, relatively slow machines of various types might be found to be very economical if the route is such that only short trips away from the ship with passengers, mails, or baggage are necessary.

Advantages of Proposed Type of Vessel.

Should these proposals be found acceptable and commercially practicable, they will not only expedite the present mail and passenger services, but will offer facilities for rapid communication with ports or inland localities which have hitherto been very badly served by offshoots from the regular passenger and mail services. For instance:—

(*a*) Vessels running on such a service from Great Britain to New York could send off aeroplanes which would reach Montreal before the steamer could get to New York. A corresponding gain would be made by Canadian steamers using the port of Halifax; on approaching Halifax the aeroplane could depart before the steamer reached the port, and *vice versâ*.

(*b*) Vessels running from Great Britain to Australia. These vessels could run to Port Said without a stop, and on their route, without stopping, could serve Lisbon, Gibraltar, Algiers, Malta, and Naples. They could then run from Suez to Colombo and deal with mails for Port Sudan, Khartoum, Aden, Somaliland, and possibly Bombay, while on the run from Colombo to Sydney, various other aerial services could be maintained.

(*c*) Vessels running from Vancouver to Hong Kong, or Australia, could in the same way deal with Pacific Islands and ports.

The design described in this paper was worked out in the first instance, and primarily, for a steamship serving as an aircraft carrier. The work has been completed on this basis, but it is considered that the resulting arrangements challenge very seriously those which have been adopted in the great majority of liners for the last thirty years.

On the usual plan the midship part of the ship is very largely taken up with funnels, uptakes, cowls, ventilating trunks, engine-room castings, &c. In the new arrangements these things are not to be found in the middle of the ship. The whole of the steam machinery is placed well aft; enormous clear decks are provided for passenger accommodation, and all the serious troubles due to overheating of passenger accommodation by the steam machinery are avoided. As electric cooking is proposed, there need be no fires or steam appliances forward or amidships except where steam appliances are fitted expressly for heating purposes.

The last thirty years have seen great developments in the machinery of liners. The reciprocating engine has given place to the steam turbine, and then to the geared steam turbine, while the internal combustion engine is also rapidly making its way. Radical improvements in steamship construction have followed on the lines, first, of the Isherwood system for longitudinal framing, and, secondly, on the straight-line system for transverse framing. But the design of the steamer herself, and the general arrangements, have only been developed in matters of detail.

The advantages of a ship designed after the style of that now suggested appear to be so great as to constitute a direct challenge to the present stereotyped arrangements for passenger liners as now built, quite apart from the question of special arrangements for carrying aircraft.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(*From our own Correspondent.*)

General Conditions.

The situation in the iron and steel trades of the Midlands, generally speaking, has become more difficult during the past week, especially with regard to supplies of raw material and fuel. The raids the Continent is making upon our fuel and raw materials have swept away the price level upon which stability was being re-established in the market and in place of enterprise there is now developing a spirit of hesitancy. Business is falling off and the transactions put through are for small tonnages. Producers will not accept forward business even at to-day's high prices. Again, this week values of most materials have become stiffer, the prevailing market tension naturally tending to give quotations an upward rather than a downward tendency. There is a shrinkage of business in the finished iron and steel branches, particularly in the former, in which the shortage of pig iron is now beginning to be seriously felt. The continuous rise in steel values is holding up development work, those who have large projects to put forward considering it wise to delay operations until values of material find their true level again. Some of the engineering branches are very adversely affected by the perturbed conditions which have arisen. It is increasingly difficult to get work to replace the contracts that are being dispatched from bridge building and constructional yards. There is an impression that British industries are finding their opportunity in the disablement of continental competitors. It is certain, however, that very little business is being diverted in that way to this district. There have been a few inquiries for structural material, which in normal circumstances would have been obtained in France, Belgium, or Germany, but the requirements have not been of any magnitude.

Manufactured Iron.

In all the finished iron departments mills are well engaged, and there is work in hand which under present conditions will take two or three months to clear off. The shortage of pig iron is beginning to tell seriously upon this side of the iron industry, and the demand from it is even greater at the present moment than from the foundries. The moderating influence which is being exercised by the makers of marked bars strongly commends itself to those who believe that nothing worse could befall the trade at this time than a false boom. Endeavouring to keep a hold on fundamentals, the marked bar makers have limited their advance, as recorded last week, to 10s., making the price £14. Pig iron has lately realised something like 40 per cent. above the prices which were being paid when the marked bar basis was fixed in April last at £13 10s., and millowners cannot tell what the price may be when they have to replenish present stocks. Consequently managements cannot see far ahead. Business in Crown bars is kept within somewhat narrow lines, as the belief prevails that prices will begin to fall on the first signs of a settlement of the Franco-German trouble. At date Crown bars are firm at £12 10s. at works. Rollers of nut and bolt bars are receiving orders in replacement of Belgian contracts that have been interrupted by the crisis. Nevertheless, the demand for nuts and bolts has diminished. While the Lancashire price for this class of bars is £11 15s., Staffordshire houses quote from £11 10s. upwards. Belgian shippers offer supplies at £10 2s. 6d. to £10 5s. delivered in the Black Country. Buyers have to take their chance as to when they will get them, however, and this is an obstacle to business. Some of the nut and bolt manufacturers are taking advantage of the lower price of steel bars, which show a saving of something like 15s. per ton. Competition among manufacturers is reported to be very keen.

Pig Iron Unprocurable.

The pig iron position has become still more acute. For current buying there is practically no pig iron on the market. The great majority of the furnace owners have closed their books. They make exceptions in favour of customers whose demands are constant, but they are not to be induced to consider forward contracts. Sales already made will absorb the output over the next month or two, and smelters are waiting for more light as to what is to happen afterwards. Specifications against existing contracts are coming forward regularly. Prices cannot be defined with any certainty. Quotations are given, such as those of £5 5s. for Northamptonshire and £5 7s. 6d. for Derbyshire and Nottinghamshire, but these are simply nominal. Pig iron producers would certainly be pleased if circumstances would permit of their getting rid of the present false price levels, which, in conjunction with the scarcity of coke, prevent the expansion of business. Many furnaces in this district would be started if the requisite coke were obtainable at an economic price. Most pig iron producers, however, are placed very much at the mercy of continental competitors in regard to their coke supplies. German manufacturers are reported to be paying £6 5s. per ton for British pig iron at the ports. Their inquiries have extended to the Midlands, but furnace owners cannot produce sufficient to supply the customers for whose necessities they feel honourably bound to provide.

Coke Shortage and Blast-furnace Inactivity.

The fuel difficulty is increasing rather than diminishing and users find supplies more scarce with each passing day. The coke required for smelting is not to be had, and thousands of tons of pig iron are being called for which cannot be supplied. Additional coke ovens are being brought into service as fast as regular supplies of coking fuel can be arranged; but the foreigner is prepared in his extremity to pay high prices for slacks as well as for coke, and this is a serious obstacle to extricating the blast-furnaces from their present predicament. The temptation to re-start furnaces in order to take advantage of the large home and foreign demand for pig iron which has recently developed is nullified by the continually increasing difficulty of obtaining coke. Even those firms which run blast-furnaces to supply their own manufacturing needs find it impossible to re-start the furnaces, preparations for the re-lighting of which have been made.

Sheet Values Recover.

Galvanised sheets have again been levelled up to the £19 10s. basis for 24-gauge corrugateds. This week the reaction which was reported in my last letter came to an end and values stiffened. On 'Change in Birmingham to-day it was impossible to buy below the £19 10s. figure. This stiffening of quotations is mainly due to the advance in sheet bar prices. It is stated that the check given to business by the previous price advances has not yet been overcome, but South Africa is providing a good market at the moment, while Japan is buying black sheets. These now command £15 at works for home consumption.

Wrought Iron Scrap.

Scrap has been in such strong request of late that extravagant prices are being quoted. For good-class wrought iron scrap some sellers this week wanted as much as £5 10s. delivered at works.

Steel Prices Stiffening.

There is still a strong demand for steel of all kinds. Nearly all the Staffordshire steel mills have raised their price for sections 5s. Small steel rounds are offered at £10 17s. 6d. to £11. This is a figure which makes them attractive to those nut and bolt manufacturers who have plant suitable for their use. In this, as in other departments of the market, there is considerable disparity in prices. Staffordshire hoops are upheld at £12 at works, but in urgent cases buyers are willing to pay a shade more. Soft billets range from £9 5s. to £9 15s. In some cases sellers ask £10. Circulars continue to be received from Belgian firms offering bars, billets, and constructional steel at prices which, with transport, come pretty near the home level, but the offers are so conditioned that buyers here are not attracted. Business at the wire mills continues brisk and most of them are booked until about the end of June, which is as far as manufacturers care to go. Wire rods have gone up to £12 10s. at works, an increase of something like £2 since the Ruhr troubles began.

Midland Iron and Steel Wages Board.

When presiding at the forty-seventh annual meeting of the Midland Iron and Steel Wages Board at Birmingham on Monday, Mr. G. H. Macpherson gave a comprehensive review of the position of the iron and steel trade. He said that, following a year of unexampled depression, there were in 1922 signs of a gradual improvement in trade, and the sales had passed through stages of 12,389 tons, 13,978 tons, 16,462 tons, 19,281 tons, and 24,503 tons, the last—for the months of November and December—being nearly 100 per cent. greater than January and February of the same year. There was, however, a fall in values of £2 6s. 5d. a ton, bringing total wages reductions of 22½ per cent. The production of wrought iron in its crude and finished forms in 1921 was 40 per cent. of that of 1920, and in 1922 it had reached 45 per cent. The production of finished steel for 1921 was 40 per cent. of 1920 and for 1922 63 per cent. It appeared that steel was recovering more rapidly than iron, and he believed that there was need for inquiry as to how iron costs could be reduced. The output of wrought iron of the three boards formed approximately the following percentages:—Midland, 73 per cent.; Scottish, 25 per cent.; and Northern, 5 per cent. The Midlands were the most handicapped in relation to export business, and it must be seriously considered how they, with their preponderating make, were to be treated as part of a national scheme. The production of pig iron in 1913 was 855,000 tons per month, and in January of this year it had reached 568,000 tons; but it was a question whether this was being maintained, owing to the insufficiency of coke preventing full running of furnaces. Referring to the general outlook, he said he thought that by the end of January the industry was entering on a slow but steady improvement. He, however, made it clear that any great optimism would not be justified, for the occupation of the Ruhr by the French, although it had forced up prices by creating a demand for finished iron and steel products, had created a hazardous situation. Above all things now, opportunism was to be deplored and condemned. After all the sacrifices made by employers and men to revivify trade, undue inflation would be a disastrous policy, to be followed by more evil consequences than those which ensued from the last boom. Mr. G. Hatton expressed apprehension of the position on the Continent. To-day it was stimulating the iron and steel trade in this country, but its effect depended upon the ultimate settlement, he said. On the whole, the tone of the speeches was much brighter than was the case last year.

The Late Mr. George Roberts.

The death is announced as having taken place, suddenly, on the 14th inst., of Mr. George Roberts, who for twenty-five years had been on the staff of the "D.P." Battery Company, Limited, of Bakewell, Derbyshire. During most of his service with the company Mr. Roberts had held the position of works superintendent.

LANCASHIRE.

(*From our own Correspondents.*)

Manchester, Thursday.

General Conditions.

The markets for iron and steel and metals remain very strong, and one sees no indication yet of any reaction, although in some sections of the market this is about due; for where speculation has prevailed, there must now be a temptation to take profits. In the iron and steel markets there has been, for a long time, almost a complete absence of the speculative influence, for merchants have been afraid either to buy or to sell without covering, but there is a much larger element of speculation in the non-ferrous markets. One might argue from this that the position in the former market is much sounder than in the latter, but it is doubtful whether this would be correct. The advance in copper, tin, &c., is not caused by the destruction of a large part of the supply; on the contrary, the output of copper is steadily increasing; but the advance in iron and steel is caused by the stoppage of supply in Germany. This is a catastrophe from one point of view, although it may be a temporary benefit to the British iron and steel manufacturers.

Metals.

The upward movement in copper, after a lull, took a further jump, and the prices are now higher than they have been for about two years. The demand in America has been very insistent, and it is this fact that has been the main support of the market; although it must be admitted that the stronger market feeling has induced some increase of buying here also. There is a little improvement in the local engineering trade which justifies some buying of copper, but it is not yet of great importance. In America it seems probable that a good deal of the buying by consumers has been in advance of requirements, and with the idea that prices were soon going to be much higher; and the effect of this forward buying by consumers may be felt later. One cannot see that the improvement, even in American trade conditions, can call for so large an increase in the actual consumption of copper as would be indicated if the buying were for actual needs. The prices for copper sheets and tubes and for brass tubes are being advanced in proportion to the rise in the raw material, although there was a hope that makers would allow the margins on manufacture to be less extravagant than they have been. One cannot believe that a difference of £30 per ton between refined ingots and strong sheets

can be a permanent necessity of the industry; or a difference of nearly £70 per ton between the raw metal and solid drawn tubes. The demand for scrap metals is still very poor here, and the prices offered by dealers for gun-metal have not responded to the big advance in copper and tin. The excuse given is that there is far too much gun-metal about just now. The market for tin has been strong at times, but there have been very violent fluctuations, and there is always the risk that any quotation given in the Press may be absurd when it comes to be published. There have been jumps of £10 per ton in a single day, and that both backward and forward. There is some doubt now as to what the Eastern holders of dear tin may do. They must be anxious to realise, after having held through so long a time, and the question is whether the market is now getting high enough to tempt them. It has been suggested that America is accumulating stocks of tin, with a view to establishing a rival to the London market in New York, and that some of the buying has this object. The demand for lead keeps very good, and prices are still inclined to be firm, but there has been no striking change in the position. More metal is now coming in, and the chances seem to be that the price is now at the top. Spelter is rather firmer, and galvanisers have been buying more freely. The importations of metal are, however, larger than they were, and the increase of 40 per cent. in the February imports over those of January is worth noting.

Pig Iron.

The market for pig iron continues to be very firm here, although there is not a great deal of business about. Sellers of Derbyshire No. 3 pig base their prices on 105s. to 107s. 6d. at the furnaces, and, roughly speaking, the price delivered in Manchester is 115s. per ton, contrasting with 90s. to 92s. 6d. when last the ironfounders were buying freely. It is perhaps natural for the consumer to struggle for a time against such an advance; but so far as can be seen, there is not much prospect of easier prices for a month or two. Much will depend upon whether all the idle furnaces can soon be brought into operation. Out of the seventy furnaces which are normally producing pig iron in the Cleveland district only forty-five are yet at work; although at present prices pig iron making in that district must be very profitable. Possibly, if the fuel supply can be secured, many of the idle furnaces will start again during the next two months, and, if so, at the end of that time there may not be such a scarcity of iron. There are also some Midland furnaces waiting for an opportunity to start. One does not expect that the Ruhr output of coal and iron will be resumed; but, of course, if that should occur the drain from this country would soon cease. There seems to be an idea that the Cleveland prices for pig iron have now reached their maximum; but even if this theory be right, it is still quite possible that the Midland prices may yet be higher. Hematite and Scotch iron are very firm here at about £7 per ton delivered; but there is very little Manchester business being done in them.

Steel.

The prices in the finished material department are very firm and are still inclined to advance. For round bar steel Midland works are quoting £12 per ton, and for common steel plates £11 to £11 10s., but apparently both in Scotland and in the North-East lower prices for finished steel are being accepted.

Scrap.

There is a better demand for steel scrap, and up to £5 per ton has been heard of in Lancashire, which would mean £5 10s. from the Sheffield works. Heavy wrought scrap is also firmer, and dealers do not now care to sell it less than £5 per ton delivered. For cast scrap there is not yet very much demand here, although it is a relatively cheap material for the ironfounder in Lancashire. Dealers here say that they cannot find many buyers even at 95s. per ton for good broken machinery iron; and it seems a shame to sell such material at £1 per ton less than the recognised price for common pig iron. It is, however, expected that so soon as the Lancashire founders find themselves compelled to buy No. 3 pig at 115s. They will be ready to pay more than 100s. for cast scrap of good quality.

Fourth Pipe Line from Thirlmere.

The Manchester Corporation has placed the contract for the self-closing valve equipment for the fourth pipe line from Lake Thirlmere to Manchester with J. Blakeborough and Sons, Limited. This contract completes the valve equipment for this line, two previous contracts having already been placed with the same firm for the sluice valves, reflux valves, automatic valves, and discharge valves, and other ironwork. The total value of the contracts amounts to about £60,000.

The Garratt Locomotive.

Speaking at a meeting of the shareholders in Beyer, Peacock and Co., Limited, the Manchester locomotive builders, a few days ago, Sir Sam Fay said that gratifying reports had reached them from South Africa regarding the working of the Garratt type of articulated locomotives which that company had developed. Special value was attached to the results of those tests owing to the severe conditions imposed by the long gradients and sharp curves encountered on South African railways. As the result of those experiences another order had recently been booked. As regards the trade outlook, Sir Sam Fay said an encouraging sign was the large number of inquiries which are now coming forward.

BARROW-IN-FURNESS, Thursday.

Hematite.

The West Coast hematite makers are in an uncomfortable position. They have furnaces which they could put in blast in the ordinary way and which, if producing iron, would help them to meet the present heavy demand, but they are in the hands of the coke producers who are unable to satisfy their requirements at present. So long as there is keen competition for coke from abroad, the makers in this district will be forced to limit their deliveries, and in consequence customers—or some of them—are not getting what they want. It is probable that only the regular customers are able to place orders for forward delivery. The increased price for fuel is affecting the cost of production, and it is doubtful if makers have a bigger margin than when trade was much quieter. There is talk of another furnace going in at Workington in a week or so, but the coke supply question will decide the matter. Prices for iron may rise still further in view of increasing costs.

Iron Ore.

The iron ore trade is good and would be better if coke was not holding smelters up. Most of the ore produced is consumed in the district, but there is a moderate delivery to both the East Coast and Scotland. Foreign ore is in better demand and is arriving more regularly.

Steel.

The steel trade is dull. Barrow is better situated than Cumberland for the rail mill is still working. At the moment it is not known when the Workington Mill will restart. The Barrow hoop and small bar mills are active, and foundries are experiencing better trade.

SHEFFIELD.

(From our own Correspondent.)

An Uneven Situation.

THE condition of the steel trade continues to present remarkable features. While one side of it is exceptionally busy, the other shows scarcely any improvement, and the relative states of the heavy and light branches afford a sharp contrast. It is still the open-hearth branch that is active, and the activity goes on increasing. Orders are rolling in upon the furnaces, not only on home account, but from foreign and colonial sources, these latter representing in many cases business that has been diverted from Germany owing to the Ruhr troubles, which are making it impossible for that country to supply. Prices of this material are constantly hardening and are now on a profitable basis. The rolling mills are busy dealing with the semi-manufactured steel, and several of them, so far from being in the depressed condition from which they were suffering only a short time ago, are now a month or more in arrears with their work and are still accumulating orders. The railway tire, axle, and spring works are also enjoying great activity, and the flow of new orders is uninterrupted.

The Darker Side.

The reverse side of the picture is presented by the lighter branches of the steel trade. Those high qualities from which cutting tools are made have not by any means shared in the improvement, and some firms are even worse placed than they were in the first month of the year, and not much better than they were in the second. The slackness in the engineering and shipbuilding trades is responsible for a very slow demand for tools such as they require in large numbers when busy. There is but a poor inquiry for edge tools, saws, cutting parts and implements for use in various industries, including agriculture. The troubles in the Ruhr have seriously affected the capacity of continental markets to buy Sheffield material, and this has meant a serious falling off of trade. The call for new production of engineers' small tools is still much handicapped by the existence of surplus war stocks.

Meeting Foreign Competition.

The Sheffield trades technical societies, which during their few years of existence have done a great deal of valuable work for the various industries they represent, have just been holding a series of useful exhibitions at the University, consisting chiefly of samples of foreign goods purchased in different quarters of the world and lent by the Overseas Trade Department of the Board of Trade. These exhibitions serve an excellent purpose in showing Sheffield manufacturers and workmen what other countries can make, and also what other countries are prepared to buy. Frequently the patterns on view are little known in Sheffield, and little suited to the taste of Sheffield producers; but the fact that there is a demand for them in some markets suggests that they are worth cultivating. Sheffield has a reputation for being conservative in its methods, and that spirit has not by any means disappeared yet, although it is weakening. An instance of the progress of the times is afforded by the fact that there are now on hand inquiries and orders for large quantities of cheap one-piece steel table knives such as are used extensively in South America, South Africa, and other countries where the standard of living is low. This trade has been almost a German monopoly, but the troubles in that country have turned the thoughts of purchasers to Sheffield, and, as the demand runs into millions a year, the department is evidently well worth cultivating. Several local firms, who have during recent years equipped themselves to compete with Germany, are benefiting from the present conditions. The cheapness of the articles produced may be judged from the fact that some of them can be offered at 3s. 6d. a dozen, a price which would have competed with German goods in pre-war days. There is nothing fresh to say generally about the cutlery and plate trades. They continue in an unsatisfactory state, except for a few firms The usual spurt in the demand which precedes Easter has hardly been noticeable this year, and the quantity of business picked up as the result of the British Industries Fair was unsatisfactory.

A Steel Firm's Gas Plant.

Interesting evidence of what can be done by industrial firms which make gas for their own works purposes is afforded by the case of Mr. George Clark, steel manufacturer, Penistone-road, Sheffield. For the past few months Mr. Clark has been running his own plant and is highly satisfied with the results. He put down three units of the open-hearth pattern, each unit having a capacity of 350 horse-power. The working load required is only about 700 horse-power, so that the total plant gives a very good margin. It is found that an equivalent of 65,000 cubic feet of town gas can be produced from one ton of anthracite coal, the cost of which, delivered at the works, is 38s. Wages, interest, and depreciation of plant work out at less than 50 per cent. of the cost of the coal, and the firm is satisfied that it is on the right side of 1s. per 1000 cubic feet of town gas. It was told that it would encounter trouble with tar deposits in the engine cylinders, and also that it would lose 15 per cent. of power as compared with the use of town gas; but Mr. Clark states that he has had no such difficulties, and in fact, the engines are running much better than formerly. The plant, he says, is showing an enormous saving, and, will pay for itself within the year. Mr. Clark adds that Sheffield manufacturers are turning their attention very seriously to producer gas for furnace work, that some plants have already been set up with satisfactory results, and that others are under consideration.

Colliery Progress.

Since my last letter the first sod has been turned of the West Thorpe Colliery at Killamarsh, which is being sunk by J. and G. Wells, Limited, of the Eckington Collieries. The pit is to be 1120ft. deep and the sinking is expected to occupy nine months. It will penetrate first to the Flockton and Parkgate seams, and coking coal will be got. An aerial ropeway will be erected from the pit to the furnaces of the Renishaw Coal and Iron Company. The colliery, when fully developed, will provide employment for from 3000 to 4000 men, and will have an output of 500,000 tons a year. Messrs. Wells have another new colliery, the Norwood, in the same district, from which a similar output is expected. Altogether they have in this area 12 square miles of land, the available coal under which is estimated at no less than 100,000,000 tons, so that a long life is in store for the new pits. Another sinking operation which has just been commenced is that at the Butterley Company's new colliery at Ollerton, on Lord Savile's estate, in Sherwood Forest. The process of freezing the water as boring proceeds will be adopted, and in the preliminary stages the sides of the shaft will be supported by concrete. The Staveley Coal and Iron Company contemplates carrying out important alterations at its Barlborough Colliery, where it is proposed to sink into the black shale seam and to develop still further the deep soft seam.

NORTH OF ENGLAND.

(From our own Correspondent.)

Cleveland Mines Crisis.

THE Cleveland ironstone mining industry is passing through a serious crisis. In the matter of working hours the industry has to shoulder a burden which applies to no other area in the country engaged in the same kind of mining and, as a consequence, the cost of winning stone is prohibitive, and many mines are laid idle. Recently the miners rejected the mineowners' proposal to revert to an eight-hour working day, which, it is claimed, will solve the problem to some extent and lead to the opening of more mines, and thus ensure better employment for the thousands of miners at present out of work. There is, however, every prospect of the miners eventually falling in with the mineowners' proposal. At a further conference this week it was announced that in view of the serious situation in the industry, the miners' executive felt compelled to reconsider the previous decision on the hours' question. A statement on the subject is to be issued to the miners' lodges, and the matter will be discussed at a special meeting of the Miners' Council next week. The owners have intimated that certain mines can be reopened in the very near future if terms can be arranged on the question of hours.

Cleveland Iron Trade.

No further progress can yet be reported in the restarting of idle blast-furnaces, but the shortage of iron is still very acute, and if only coke were available, work could be found for most of the plant still remaining idle. There is, however, a perceptible falling off in the inquiry, due probably to the difficulty of getting prompt delivery of pig iron of any description, the high prices now ruling, and the approach of the holidays. Prices have reached a level which consumers hesitate to pay except for small parcels to cover urgent needs, and there is little inducement to buy forward. Forward business is, in fact, a pure gamble. Prices may move higher; indeed, as coke is reported to have been sold for export at 90s. per ton, prices will probably move upwards, but the whole situation is artificial. Certainly present conditions are not healthy. Dear fuel has rushed up the cost of pig iron production, and the old vicious circle is actively revolving once more. It is all very well so long as the rise continues, but it cannot go on for ever, and when the reverse process sets in the consequences may be disastrous for local industry. There is very little iron available for prompt delivery, and for April–May No. 1 Cleveland is quoted at 130s.; No. 3 G.M.B., 127s. 6d.; No 4 foundry, 125s.; and No. 4 forge, 117s. 6d. to 120s.

Hematite Pig Iron.

In the East Coast hematite pig iron trade home consumers are still clamouring for supplies, and the demand from abroad is expanding on a large scale. Mixed numbers have been sold for forward delivery at 125s. per ton, and No. 1 at 126s., but it is probable that higher prices would be paid if reasonably prompt delivery could be given. But makers are choked with orders, and in many cases quote still higher prices to put a curb upon business which they cannot undertake.

Iron-making Materials.

The foreign ore trade continues quiet. Consumers appear to have covered their needs for some time to come, and are not willing to commit themselves further, and are only buying odd cargoes at cut prices. Best Rubio ore is now offered at 24s. 9d. per ton c.i.f. Tees. For blast-furnace coke the nominal price to the ironmasters is 40s. per ton delivered at the works. This price, of course, bears no relation to the huge export quotations.

Manufactured Iron and Steel.

More encouraging accounts are given of the manufactured iron and steel trade. The recent advances have not arrested the demand. Buyers are showing a readier disposition to place orders, and the export trade is also more active. Railway material is in good request, and the supply of billets is scarcely sufficient to meet the requirements of the trade. There have been no further advances, but prices are firmly maintained.

The Coal Trade.

The Northern coal trade situation is, on the whole, quiet and restrained. There is something of a lull in the operations, which is in striking contrast to the conditions prevailing a little while ago. The continental trade has quietened down quite definitely, and though the present pause is not expected to last for more than a few days, there is just now a falling off in the urgent inquiries, not only from Germany, but from other continental centres. The French action in the Rhur is the occasion of the halt in the upward trend, but once this vexed problem is straightened out the outlook will be at least clearer, and operators will be able to move much more confidently. The Northumberland steam coal market is very firm up to the end of the current half year, but for July to December loadings there is a disposition to hold off for the present. Despite this, however, the collieries adhere to their quotations for every class of steams, including smalls, both first and second grades. Durham gas coals are appreciably quieter. There is now no rush for supplies, for most people are moving very slowly if at all, until the political atmosphere abroad is clearer and more understandable than at present. The best brands of gas coals are scarce, but there are supplies of the commoner kinds available at current figures. A further fillip has been given to the coke market. Foundry cokes of every make are stronger, with 80s. paid for patent oven coke for April delivery, and the same figure quoted for May. Gas coke is unchanged, but is very steady throughout.

Ironworks to be Re-started.

After standing idle for practically two years, there is a prospect of work being resumed in the near future at the Thornaby-on-Tees Ironworks of William Whitwell and Co., Limited. The negotiations for the reconstruction, which have been proceeding for some time, are now completed. The Thornaby ironworks comprise one of the most up-to-date ironworks plant in the North of England. There are three blast-furnaces, and a new installation of coke ovens and by-product plant.

SCOTLAND.

(From our own Correspondent.)

Clyde Emigration—Large Total.

The opening of the emigration season has witnessed a large number of departures for Canada and America. Last week-end and within twenty-four hours four steamers left the Clyde carrying an aggregate of over three thousand passengers. The pressure has been so great that the C.P.R. steamer Marlock had to proceed here from Liverpool to embark 300 Scottish passengers. Advance bookings are also heavy. For instance, the Metagama, which sailed last week-end, is due to leave the Clyde again on April 20th, and already the entire third-class accommodation is fully booked along with 350 cabin berths. The steamer Montcalm will also be brought round from Liverpool to embark Clyde passengers.

Markets Generally Firm.

Industrial conditions show little change on the week. The continued firmness in the various markets, though producing greater caution in buying, has not yet seriously curtailed business. The production of material is hampered by a lack of raw stuffs, especially of continental origin. Far Eastern markets show increased activity in various classes of materials, and with supplies restricted, makers are finding little difficulty in securing the prices asked. It is said, however, that the rise in values will soon be reflected in a decreased rate of expansion in the shipbuilding trade.

Strong Pig Iron Market.

Pig iron makers still experience a ready demand for hematite for local consumption, and the price continues round about £6 per ton for Glasgow delivery. Foundry qualities are meeting with an increasing home and export inquiry, and with outputs restricted, makers' ideas of prices are very firm. Latest quotations show a rise of 3s. 6d. per ton at £6 3s. 0d. for No. 1, and £5 18s. 6d. per ton for No. 3, but higher quotations are likely in the immediate future.

Demand for Export Steel and Iron.

Almost all descriptions of steel and iron products have a ready export demand at present. Local makers are reaping some benefit from the cutting off of continental supplies. Steel plates are not too busy, but sheets of the lighter gauges especially are booking well for forward delivery, despite the rise in prices, consequent on dearer and less abundant raw materials. Light sectional material also is busy. Bar iron works are doing comparatively well generally and are busy in the re-rolled steel department. A steady and increasing demand is noticeable in various directions, such as locomotive and wagon building and constructional and general engineering. In these departments good contracts are on hand, and inquiries of considerable importance are mentioned. The danger of inflated prices is constantly being referred to, and while some producers are prepared to take full advantage of the ruling conditions, many are anxious to keep prices from becoming a sure barrier to progress.

Coal—Heavy Export Bookings.

The demand for Scotch coal for export shows little if any abatement. The collieries everywhere are booked up for weeks ahead, and practically nothing of a prompt nature is available. An occasional lot is being disposed of second-hand, but the collieries have really as much as, and, in fact, on many occasions more, than they can do to overtake their commitments. A considerable amount of forward booking has been, and is being, indulged in. Apart from quantities for Germany, orders have come from the United States, Canada, Spain, Italy, France, and Belgium. The shipments week by week are very large and would be bigger still were it not for the congestion at the colliery sidings and the loading stations, owing partly to the irregular arrival of steamers. Aggregate shipments for the past week amounted to 344,952 tons, against 353,864 tons in the preceding week week, and 273,505 tons in the same week last year. With the export demand so heavy local consumers are finding difficulty in securing adequate supplies, even though they may be prepared to pay the higher prices asked.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Position.

The steam coal trade is exceedingly firm, and there is every prospect that these conditions will be seen certainly for the next month or two if not longer. The situation is rendered at the moment even more difficult from the point of view of getting supplies, as there are about 17,000 men out on strike on the non-unionist question, and, of course, this means a serious limitation of output, in addition to which it has to be remembered that the Easter holidays will entail the loss of the best part of a week's production. As things are, prices of superior qualities of steam coal are practically nominal, as colliery salesmen have none to spare for shipment during the remainder of this month and the early part next, and they are not anxious to sell ahead, as it is impossible to tell what may be the conditions. The demand for coals is still fairly active for Germany, Belgium and France; but so far as Italy is concerned, the inquiry for the moment is rather limited. Shipments to Italy have been somewhat heavy, and until the present stocks are diminished, buyers are inclined to hold their hands. The political situation on the Continent is naturally being closely watched, as it is believed in some quarters that an agreement between France and Germany on the reparation question will materially affect this market. On the other hand, this view is not held in other directions, as it is thought that France will retain her supervision of the Ruhr coalfield for some time, and that Germany's requirements from this country will be considerable for some time to come. Reports are current that a substantial amount of business has been done for Germany up to the end of this year, a quarter of a million tons being mentioned as having been placed for Admiralty coals apart from operations in other qualities. It is also reported that the Russians are inquiring for a quarter million tons, and that the Italian Marine is likely to require a hundred thousand tons of large steam coals. The Swiss Railways were recently in the market for 60,000 tons of patent fuel; but on account of the high price demanded, it is understood that they are not buying fuel but are asking for prices for steam coal. It is not improbable that the Egyptian State Railways will again be in the market for supplies of locomotive coals before very long. Notwithstanding the high prices prevailing, the inquiry is very active, but it is quite another matter to be able to get the coal.

Non-Unionist Trouble.

Trouble has been brewing in the South Wales coalfield for some time past on the non-unionist question. The Federation has been carrying on a campaign for several months, but the non-unionists have not been rejoining the fold anything like as quickly as the officials desired, with the result that in the last fortnight the pressure has been put on. The Federation has aimed at getting back to the organisation not only those miners who have fallen out of membership but also those who belong to the Craftsmen's Union. The latter are regarded as much as non-unionists as those workmen who belong to no union, and this has caused a good deal of friction, as, for instance, at the Nine Mile Point Collieries, where there has been a stoppage of work for the past six weeks. Notices which were recently tendered in the Ogmore, Garw and Maesteg districts expired on Saturday last, and the leaders decided that the notices were to be enforced, with the result that this week about 17,000 men have been idle. From all accounts the strike is causing non-unionists to fall into line, and it is reported that quite a number of craftsmen have given way and agreed to forsake their own union in order to become members of the Federation. In the Rhondda the miners were ordered by their official leaders to hand in fourteen days' notices on the non-unionist question by noon on Monday last, but the returns show that more than 50 per cent. of the 30,000 workmen have not carried out the instruction of their leaders. The management of the Ocean Colliery Company's pits in the Rhondda district refused to accept the notices tendered, as they were handed in tied up in bundles and not by each man individually, the assumption being the view was held that the chances were that all the men affected were not free agents in the matter. It is impossible to say at the moment what may develop from the present situation.

Miners' Wages.

A special delegate conference of the South Wales Miners' Federation was held at Cardiff on Monday last, when the national wage agreement came up for consideration. The recommendation of the Executive Council was adopted, giving authority to the representatives at the forthcoming national conference to vote for the termination of the agreement with a view to insisting upon a higher rate of wages. Several delegates sought to include a demand for an amendment of the agreement in other directions as, for instance, that in relation to the share of the surplus profits and the exclusion of many items at present included in the cost of production, which the miners contended should not be allowed; but these matters were held over for the time being.

Docks Working Hours.

Representatives of the employers and the tippers and trimmers who met on Thursday in last week at the Ministry of Labour in London again failed to come to an agreement on the question of the introduction of a third shift, and the upshot was that the representatives of the employers intimated that they would apply for a Court of Inquiry to be set up to decide the issue. The Ministry assented to this course. Since then the secretary of the Coalowners' Association has received a communication from the Ministry of Labour stating that Sir Montague Barlow has decided to appoint a Court of Inquiry with the following terms of reference:—"To inquire into the necessity of putting on a third shift for coal tippers and trimmers in the South Wales coal exporting district." The court will be constituted of a chairman and two representatives of the employers and two representatives of the workmen. The National Transport Workers' Federation and the National Union of Railwaymen have appointed Mr. J. T. Clatworthy (president of the Cardiff, Penarth and Barry Coaltrimmers' Union), and Mr. C. T. Cramp (industrial secretary of the National Union of Railwaymen) to represent the workmen.

Coalowners and Output.

At the annual meeting of the South Wales Coalowners' Association held last week, a statement was presented by the secretary giving particulars of the output of the members for the year ending December 31st last. This statement showed that the total was 47,157,690 tons, being an increase of 18,553,226 tons over the previous year, equal to 65.1 per cent. It was, of course, pointed out that in 1921 there was a three months' stoppage in the coalfield. The figures given regarding assurances for 1923–4 were as follows:—Cardiff district, 32,189,819 tons; Newport district, 13,487,741 tons; making a total of 51,303,374 tons, an increase of 6,489,897 tons, a percentage increase of 14.5. The secretary stated that both the output and the quantity assured were the highest in the history of the association, and that the latter now embraced colliery companies which produced approximately 94 per cent. of the output of the coalfield.

Current Business.

The general inquiry on the steam coal market continues to be well maintained, but actual business for fairly early loading is very restricted, for the reason that collieries are so fully sold, in addition to which salesmen are more cautious than ever about entering into fresh commitments, owing to the strike in the coalfield on the non-unionist question and the fear that the stoppages may extend. Prices of coals are very difficult to gauge with accuracy, as it is so much a matter of individual position, but best Admiralty large are freely quoted at 37s. 6d., and in some instances up to 40s.; while second qualities are round about 35s. to 36s. Monmouthshire large range about 34s. to 36s., according to quality. Highly bituminous coals are practically unobtainable for some weeks. Small coals are scarce and best descriptions rule from 27s. 6d. to 30s., inferior sorts commanding from 20s. to 23s. 6d. Anthracite coals are firmer, and patent fuel is higher in price, quotations being from 40s. to 45s. The first cargo of pitch from the Gulf of Mexico has arrived; but although the cost is lower than the British product, makers of patent fuel are forced to advance their prices on account of the dearness of small coals. As regards work at the docks at Easter time, it has been decided that work should finish at 10 p.m. on Thursday, March 29th, and recommence on Saturday, March 31st, at 6 a.m. until noon and up to 1 p.m. to finish vessels. Work will then cease until 6 a.m. on Tuesday, April 3rd, and again finish at 6 p.m. on the same night. Loading and trimming operations will be recommenced at 6 a.m. on Wednesday, April 4th, and go on as usual.

Latest News from the Provinces.

WALES AND ADJOINING COUNTIES.

Docks Working Hours.

Mr. Lewis Lougher and Mr. T. H. Rendell have been nominated to represent the employers on the Court of Inquiry which the Ministry of Labour is appointing to inquire into the question of the necessity of a third trimming shift at South Wales ports. Mr. John A. Compston, K.C., will be the chairman.

Swansea Metal Exchange.

The tin-plate market is very firm. There has recently been good continental buying, and many tin-plate manufacturers are now well booked up for orders. Sellers now are not inclined to operate for fresh business during the next three months, and are quoting 24s. 6d. basis I.C. f.o.b. works, which is 2s. above the minimum.

Miners' Strike.

The stoppage of work by miners in the Ogmore, Maesteg and Garw districts on the question of non-unionism looks like terminating this week, as non-unionists are rejoining the Federation. In the case of notices in the Rhondda district, the leaders contend that sufficient men have put in notices to justify a strike, and there will be a district meeting on the 31st inst. to decide definitely whether there shall be a strike or the notices be withdrawn.

Current Prices for Metals and Fuels.

IRON ORE.

N W. Coast—	
Native	22/6
(1) Spanish	23/-
(1) N. African	23/-
N.E. Coast—	
Native	—
Foreign (c.i.f.)	24/9

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	6 7 6	—
No. 1 Foundry	6 5 0	—
No. 3 Foundry	6 0 0	—
N.E. Coast—		
Hematite Mixed Nos. ...	6 5 0	6 5 0
No. 1	6 6 0	6 6 0
Cleveland—		
No. 1	6 10 0	6 10 0
Silicious Iron	6 10 0	6 10 0
No. 3 G.M.B.	6 7 6	6 7 6
No. 4 Foundry	6 5 0	6 5 0
No. 4 Forge	6 0 0	6 0 0
Mottled	—	—
White	—	—
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast) ...	13 0 0	—
North Staffs. Forge * ...	—	—
,, ,, Foundry ...	5 12 6	—
(3) Northampton—		
Foundry No. 3 *	—	—
,, Forge *	—	—
(3) Derbyshire—		
No. 3 Foundry	5 7 0 to 5 10 0	
Forge	4 17 0 to 5 5 0	
(3) Lincolnshire—		
Basic ... (none offering)	6 0 0 to 6 10 0	
Foundry	5 10 0	—
Forge	5 5 0	—
(4) N.W. Coast—		
N. Lancs. and Cum.		
Hematite Mixed Nos. ...	6 17 6	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	12 0 0	—
Best ,, ...	—	—
N.E. Coast—		
Crown Bars	12 0 0	—
Tees	10 0 0	—
Lanc.—		
Crown Bars	12 0 0	—
Second Quality Bars ...	11 5 0	—
Hoops	15 0 0	14 15 0
S. Yorks.—		
Crown Bars	12 10 0	—
Best ,, ...	13 10 0	—
Hoops	15 10 0	—
Midlands—		
Crown Bars	12 0 0 to 12 10 0	
Marked Bars (Staffs.) ...	14 0 0	—
Nut and Bolt Bars ...	11 10 0 to 11 15 0	
Gas Tube Strip	12 10 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	13 0 0	—
Ship Plates ⅜in. and up	9 15 0	—
Sections	9 5 0	—
Steel Sheets ⅛in. to ¼in.	12 0 0	—
Sheets (Gal. Cor. 24 B.G.)	—	19 5 0

STEEL (continued)

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	10 10 0	—
Angles	10 0 0	—
Boiler Plates	14 0 0	—
Joists	10 0 0	—
Heavy Rails	10 10 0	—
Fish-plates	14 10 0	—
Channels	9 5 0	—
Hard Billets	10 5 0	—
Soft Billets	10 0 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	9 10 0	—
Light ,, ...	11 0 0	—
Billets	10 0 0	—
Manchester—		
Bars (Round)	12 0 0	—
,, (others)	10 15 0 to 11 0 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel) ...	13 15 0	13 10 0
Plates	11 0 0 to 11 10 0	
,, (Lanes. Boiler) ...	13 10 0	—
Sheffield—		
Siemens Acid Billets ...	13 0 0	—
Bessemer Billets	13 10 0	—
Hard Basic	10 10 0 to 10 15 0	
Intermediate Basic ...	10 10 0	—
Soft Basic	10 0 0	—
Hoops	12 15 0 to 13 5 0	
Soft Wire Rods	13 0 0 to 13 10 0	
Midlands—		
Small Rolled Bars	10 17 6 to 11 0 0	
Billets and Sheet-bars ...	9 5 0 to 9 15 0	
Gas Tube Strip	10 15 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets (f.o.b. L'pool)	19 0 0 to 19 10 0	
Angles	10 0 0 to 10 5 0	
Joists	10 0 0 to 10 5 0	
Tees	11 0 0 to 11 5 0	
Bridge and Tank Plates	10 10 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	24/- to 24/6
Block Tin (cash)	222 17 6
,, (three months)	223 10 0
Copper (cash)	75 17 6
,, (three months)	76 10 0
Spanish Lead (cash)	29 0 0
,, (three months)	29 0 0
Spelter (cash)	37 7 6
,, (three months)	37 7 6
Manchester—	
Copper, Best Selected Ingots	78 0 0
,, Electrolytic	83 0 0
,, Strong Sheets	106 0 0
,, Loco Tubes	0 1 2½
Brass Loco Tubes	0 1 0¾
,, Condenser	0 1 2½
Lead, English	30 10 0
,, Foreign	29 10 0

FERRO ALLOYS.

(All prices now nominal.)

Tungsten Metal Powder	1/11 per lb.	
Ferro Tungsten	1/5 per lb.	
	Per Ton.	Per Unit
Ferro Chrome, 4 p.c. to 6 p.c. carbon ...	£23	10/6
,, 6 p.c. to 8 p.c. ,,	£21 0 0	8/-
,, 8 p.c. to 10 p.c. ,,	£20 0 0	8/-
,, Specially Refined ...		
,, Max. 2 p.c. carbon	£52 0 0	20/-
,, ,, 1 p.c. ,, ...	£62 0 0	22/6
,, ,, 0·75 p.c. carbon	£72 0 0	25/-
,, carbon free	1,6 per lb.	
Metallic Chromium	4/6 per lb.	
Ferro Manganese ... ... (per ton)	£16 for home.	
,, Silicon, 45 p.c. to 50 p.c.	£12 5 0 scale 5/- per unit	
,, ,, 75 p.c.	£20 0 0 scale 6/- per unit	
,, Vanadium	17/- per lb.	
,, Molybdenum	9/- per lb.	
,, Titanium (carbon free)	1/1 per lb.	
Nickel (per ton)	£130	
Cobalt	12/- per lb.	
Aluminium (per ton)	£82 to £100	

(British Official.)

FUELS.

SCOTLAND.

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	28/6
,, ,, Ell	29/6
,, ,, Splint	32/- to 35/-
,, ,, Trebles	31/-
,, ,, Doubles	30/6
,, ,, Singles	30/-
Ayrshire—	
(f.o.b. Ports)—Steam	28/6
,, ,, Splint	32/-
,, ,, Trebles	31/-
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	31/- to 35/-
Screened Navigation	36/-
Trebles	31/6
Doubles	30/6
Singles	30/6
Lothians—	
(f.o.b. Leith)—Best Steam	31/6
Secondary Steam	30/6
Trebles	31/6
Doubles	31/-
Singles	30/6

ENGLAND.

(8) N.W. Coast—	
Steams	39/6
Household	46/8 to 57/6
Coke	42/6
Northumberland—	
Best Steams	33/6 to 35/-
Second Steams	30/- to 31/-
Steam Smalls	22/- to 25/-
Unscreened	20/6
Household	25/- to 28/-
Durham—	
Best Gas	33/- to 35/-
Second	32/6
Household	25/- to 28/-
Foundry Coke	77/6 to 80/-

	Inland.	
Sheffield—		
Best Hand-picked Branch ...	32/6 to 34/6	—
Barnsley Best Silkstone	28/- to 30/-	—
Derbyshire Best Brights ...	25/6 to 27/6	—
,, ,, House	23/- to 24/6	—
,, ,, Large Nuts ...	21/6 to 22/6	—
,, ,, Small ,, ...	17/- to 19/-	—
Yorkshire Hards	22/- to 24/-	—
Derbyshire ,, ...	21/- to 24/-	—
Rough Slacks	11/- to 12/6	—
Nutty ,, ...	10/- to 12/-	—
Smalls	6 - to 8/	—
Blast Furnace Coke (Inland and Export) ...	24/- to 30/-	

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	37/- to 38/-
Second ,, ,, ...	35/- to 37/-
Best Dry Large	34/- to 36/-
Ordinary Dry Large	31/6 to 33/6
Best Black Vein Large	35/- to 36/-
Western Valley ,, ...	34/- to 35/-
Best Eastern Valley Large	34/- to 35/-
Ordinary ,, ,, ...	31/- to 33/-
Best Steam Smalls	27/6 to 30/-
Ordinary ,, ...	25/- to 27/6
Washed Nuts	30/- to 32/6
No. 3 Rhondda Large	33/- to 35/-
,, ,, Smalls	27/- to 28/-
No. 2 ,, Large	30/- to 32/-
,, ,, Through	27/6 to 28/6
,, ,, Smalls	23/- to 25/-
Coke (export)	70/- to 80/-
Patent Fuel	40/- to 45/-
Pitwood (ex ship)	25/- to 25/6
Swansea—	
Anthracite Coals:	
Best Big Vein Large	40/- to 45/-
Seconds	35/- to 40/-
Red Vein	30/- to 32/6
Machine-made Cobbles	47/6 to 50/-
Nuts	47/6 to 50/-
Beans	45/- to 47/6
Peas	20/- to 22/-
Breaker Duff	12/- to 13/-
Rubbly Culm	15/- to 16/-
Steam Coals:	
Large	28/- to 30/-
Seconds	26/- to 27/-
Smalls	17/- to 20/-
Cargo Through	23/- to 25/-

(1) Delivered. (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—F.O.B. Glasgow.

(8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export and coke is per ton on rail at ovens and f.o.b. for export (9) Per ton f.o.b

* Quotations extremely high and nominal.

French Engineering Notes.

(From our Correspondent in Paris.)

Coke Supplies.

WHATEVER may be the issue of the Ruhr occupation, there appears to be some hope of coke being sent to this country in quantities sufficient to permit of a number of furnaces being put in blast. So large are the stocks of coke that have been accumulating in the Ruhr through the impossibility of delivering it into unoccupied Germany that the French are taking measures to get the stocks away, and, the railway service being now fairly well organised with the aid of French railwaymen, the coke ovens have been taken over and French labourers, under military protection, are loading the stocks on to wagons. It is stated that from 500 to 600 tons a day are now being sent to France, and the quantity will be increased until the daily consignments amount to about 4000 tons. It is uncertain what will be done when the stocks are exhausted, for the Germans have ceased work at places in possession of the French and no more coke is being produced. The importation of 30,000 tons a month from Belgium in exchange for scrap iron is also helping to relieve the situation, and in a general way there is a rather more confident feeling, as is evidenced in the arrest of the upward movement in iron and steel prices."

Electrical Distribution.

In the carrying out of the national electrification scheme a large proportion of the total energy will be drawn from the mountain range known as the Massif Central. One of the principal works in this connection is the construction of the Eguzon barrage in the Indre, having a length of 255 m. and a height of 62 m. It will hold back the waters of the Creuze and create a lake of 55 million cubic metres capacity. The power station will be equipped with five groups of turbo-alternators, producing current under a tension of 10,000 volts. This will be raised by transformers to 90,000 and 150,000 volts. Two transmission lines are to be run between Eguzon and Paris so that the Gennevilliers power station may supply energy in default of the hydro-electric plant for the electrification of the Paris-Orleans line between Paris and Châteauroux. The works have to be completed by the beginning of 1925, and to permit of the construction of the barrage and power station a tunnel has been driven through exceedingly hard rock so as to carry the water of the Creuze under the bed of the river. The length of the tunnel is 120 m., and the section is sufficient for a discharge of 500 cubic metres a second. All the preliminary works have been completed, together with the foundations of the power station, and the construction of the barrage will be started shortly.

Laboratories.

The idea of bringing sport to the aid of scientific research seems likely to give highly satisfactory results, for even before the programme was drawn up offerings were spontaneously made, amounting to a considerable sum of money, for the equipment and endowment of laboratories. The laboratory installations are often severely criticised, and yet valuable work is done in them; but it is recognised that the country's future depends upon scientific research, as applied chiefly to industrial development, and that this can only be assured by providing workers in the field of scientific research with more ample facilities than they possess at present. Seeing that so much money is spent upon the various sporting manifestations, a series of sporting events, which it is hoped will realise several million francs, has been arranged. Already there has been an anonymous gift of a million and many others of smaller amounts, and the laboratories appear assured of benefiting considerably from this temporary and lucrative association with sport. Meanwhile, the movement is rapidly extending in other directions, and at some engineering works the men have agreed to work one hour for the laboratories.

Suction Gas Lorries.

The trials carried out last year with suction gas lorries showed that really satisfactory results could only be obtained with specially designed engines, or, rather, gas engines as distinct from petrol motors. While these latter gave a much lower efficiency on suction gas, they nevertheless revealed an appreciable economy in the running cost per ton-mile, and there is no doubt that with gas engines adapted to lorries the economy will be much greater because the efficiency will be higher. It has therefore been decided to organise another series of trials this year for lorries fitted with engines designed for running on suction gas, either special engines or ordinary engines transformed for the purpose. They must nevertheless be able to run on petrol in case of emergency. The lorries will be divided into two categories carrying loads of 3½ and 5 tons. The only fuels permitted for the producers are charcoal and wood. The trials will begin on October 1st next, and entries may be sent before July 1st to the Technical Commission of the Automobile Club de France, which is organising the trials together with the Office National des Recherches et Inventions and the technical services of the Ministry of War.

Flood Protection.

The alarm caused by the recent flooding of the Seine has not only given additional importance to the programme of works, which include the deepening of the river between Paris and Rouen and the construction of a canal from the Marne to the Seine at Gennevilliers, but it has resulted in the preparation of another project that aims at the creation of "flood reservoirs" above Paris. As it now appears improbable that the Marne canal will be constructed the reservoirs are believed to offer the most effective means of preserving Paris from the danger of inundation. The "flood reservoirs" will have a capacity of 2352 million cubic metres, by means of which it is hoped to prevent the Seine, as it passes through the city, from rising to dangerously high levels. The reservoirs will also be employed for supplying additional water to the capital and for producing electrical energy.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

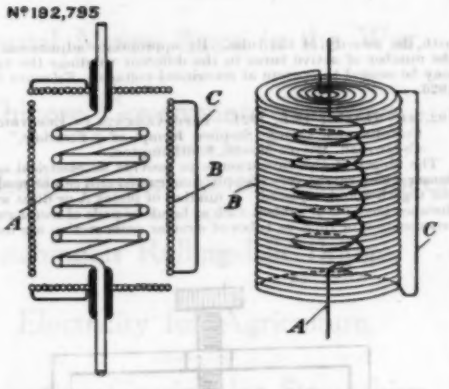
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

TELEGRAPHS AND TELEPHONES

192,795. November 11th, 1921.—IMPROVEMENTS IN AND RELATING TO HIGH FREQUENCY ELECTRICAL COILS, MORE PARTICULARLY APPLICABLE TO WIRELESS AERIAL COILS, Lionel George Preston, C.B., Captain, Royal Navy, and Newton Shuttleworth, both of H.M. Signal School, Royal Naval Barracks, Portsmouth.

This invention relates to high-frequency electrical coils or circuits having a considerable number of ampere turns and more particularly to coils that are employed in wireless telegraphy,

Nº 192,795

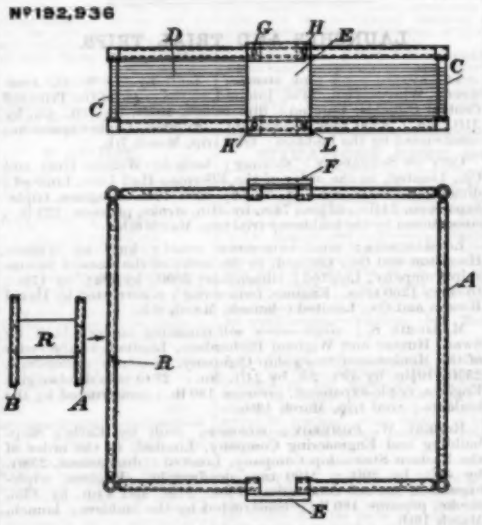


such as aerial coils. In order to economise space and improve the efficiency the coils are surrounded by other coils, which are wholly or partially short circuited. In the drawings the main coil is shown at A and the protecting coil at B, whilst the short-circuiting connection is shown at C.—*February 12th*, 1923.

192,936. February 28th, 1922.—IMPROVEMENTS IN COILS OR THE LIKE FOR WIRELESS APPARATUS AND OTHER PURPOSES, William Edward Barber and Henry John Warner, of Instrument Design Establishment, Royal Air Force, Biggin Hill, Kent.

This invention relates mainly to the construction of large rotable coils or frame aerials for directional wireless reception and transmission in which it is desirable to make the coil light and strong. The coil comprises two rectangular metal frames A and B, the corresponding corners of which are joined together by rods or distance pieces C of insulating material, on which the wire D of the coil is wound. Three of the sides of each frame are continuous, whilst the fourth or lowest side is interrupted and clamped to a plate E of wood or other insulating material extending between the two frames. The frameworks are also

Nº 192,936



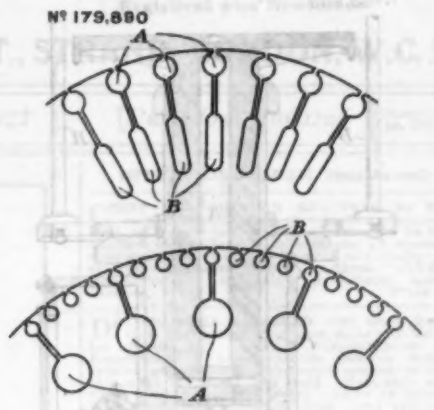
joined together at the top by a plate F of wood or other insulating material. Four terminals G, H, K, L are arranged on the plate E. The ends of the wire of the coil are joined to the terminals H and K and the terminals G and L form the terminals of the coil as a whole, the circuit being from the terminal G around the frame to the terminal H, through the wire D to the terminal K and around the frame B to the terminal L. The frames are made up of metal tubes, which are connected together at the corners by angle members, which have an eye to receive the ends of the rods C and two limbs in the form of plugs which enter the ends of the tubes. At the right and left-hand sides coil boards are fixed, to which the various turns or convolutions of the wire of the coil are clamped between layers of cloth.—*February 15th*, 1923.

DYNAMOS AND MOTORS.

179,890. February 7th, 1923.—IMPROVEMENTS IN OR RELATING TO INDUCTION MOTORS, Naamlooze Vennootschap Hengelosche Electrische en Mechanische Apparatenfabriek, of Bornesche Straat 5, Hengelo, Holland.

This invention relates to induction motors having two squirrel-cage rotor windings, one of relatively high ohmic resistance and low self-induction for starting purposes, and the other of relatively small ohmic resistance and high self-induction for normal running purposes. A nearly ideal combination of the values of the self-induction and ohmic resistance of the two windings is obtained by disposing the starting winding, *i.e.*, the winding of high resistance and small reactance in slots A near the periphery of the rotor and by disposing the working or small resistance and

Nº 179,890



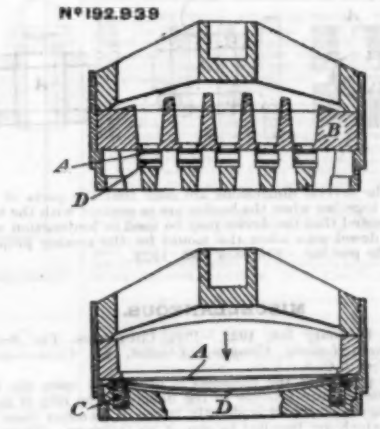
high reactance windings in partially open slots B which are relatively few in number and are at a greater distance from the periphery than the slots which are provided for the starting winding.—*February 7th*, 1923.

PUMPING AND BLOWING MACHINERY.

192,939. February 28th, 1922.—AUTOMATIC PLATE VALVES, *E. C. R. Marks, 57 and 58, Lincoln's Inn-fields, London*, W.C. 2.

This valve is intended for high-speed air compressors, and is claimed to eliminate localised bending of the valve plate, with its consequent crystallisation. The valve shown opens downwards and comprises a series of spring strips A A, which close up against the seating block B. The outer ends of the strips

Nº 192,939



are bent downward and are held up to the seating by small springs C. Below each valve there is another bent strip D, against which it bears when open. It is said that during the action of opening the valve strips roll over the abutments at their ends, that localised bending is eliminated and that friction is reduced to a minimum.—*February 15th*, 1923.

192,760. November 7th, 1921.—CENTRIFUGAL FANS, J. Howden and Co., Limited, and W. H. Howden, 195, Scotland-street, Glasgow.

In this fan the impeller is built up of a hollow two-part boss A A, between the two halves of which the plate rings B B are clamped. The blades C C are riveted to these rings, which take

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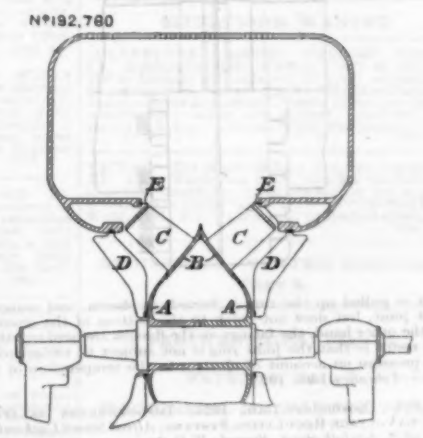

up the centrifugal stresses, so that the boss is not subjected to any radial forces. Guide vanes D D are fixed to the casing at the inlets, while brass strips E E reduce the clearance between the impeller and casing.—*February 7th*, 1923.

MACHINE TOOLS AND SHOP APPLIANCES.

192,896. January 17th, 1922.—MOULDING MACHINES, C. Scampton, 8, St. Ann's-road, Coventry.

In this moulding machine there is a main jarring ram A, worked by compressed air. The stripping stools B are raised by the annular ram C. The cylinder for this ram is in communication with an oil reservoir, through a poppet valve D,

which opens outwards. Compressed air can be admitted above the oil in the reservoir, when the oil is forced through small holes in the valve D, so that the stripping plate is slowly raised.

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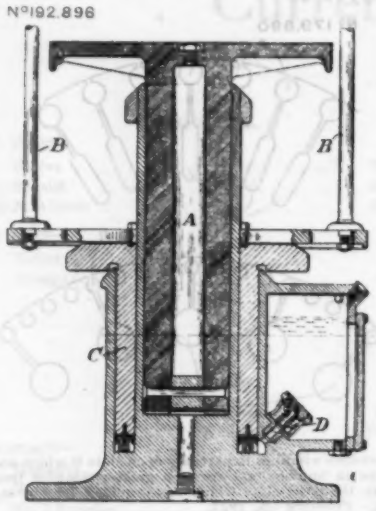
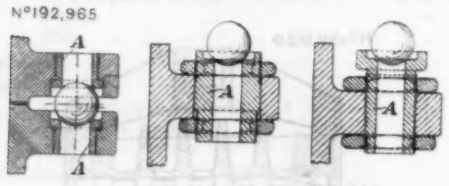


When the air pressure is released the valve D opens and the ram descends quickly.—*February 15th*, 1923.

192,965. April 6th, 1922.—MOULDING BOX DOWELS, Sir Henry Fowler, Saxelby House, Osmaston-road, Derby, and G. Chambers, 27, Arboretum-street, Derby.

This device is intended for registering the parts of moulding boxes used in foundries, and its form is fairly obvious in the drawings, which show alternative arrangements. Bushes A A are fixed in lugs on the parts of the box and a ball seated between

N°192,965



them. The several dimensions are such that the parts of the box close together when the bushes are in contact with the ball. It is suggested that the device may be used in conjunction with ordinary dowel pins when the mould for the casting projects beyond the parting.—*February 15th*, 1923.

MISCELLANEOUS.

192,920. February 7th, 1922.—PIPE COUPLINGS, *The British Thomson-Houston Company, Limited*, 83, *Cannon-street, London, E.C.* 4.

In this pipe joint the tightness is dependent upon the ring A being forced into grooves in the flanges. The ring is made of a springy metal, and is slightly larger in diameter than the grooves, which are bevelled to give it an entrance. When the

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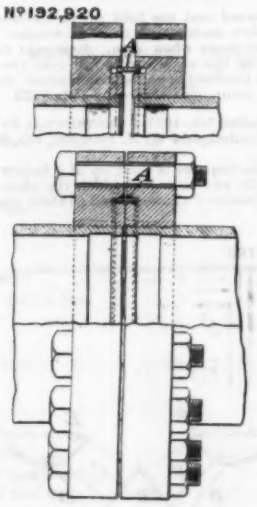

joint is pulled up the ring is bowed, as shown, and makes a tight joint, but does not reach to the bottom of the grooves. On the other hand, the facings on the flanges are hard together. The result is that the joint ring is not subject to variations in end pressure on account of changes in the temperature of the pipe.—*February 15th*, 1923.

192,806. November 15th, 1921.—IMPROVEMENTS RELATING TO VOLTAGE REGULATING SYSTEMS, *Alfred Stuart Cachemille, of 2, Norfolk-street, Strand, W.C.* 2.

In the voltage regulating system described in this specification an electron tube of the hot cathode type is employed, and it has its cathode temperature determined by the supply voltage, and the plate current flows through a transformer in such a manner as to "buck" or oppose a transformer winding energised directly from the supply. By this means a differential effect is produced and a constant voltage is maintained on the load circuit. In the case illustrated the supply mains are connected to the terminals of an auto-transformer winding A having taps B, C, D, and E. A single electron tube is employed having a cathode F and anodes G and H. A transformer is provided having primary windings K and L and a secondary winding M. The anodes are connected to the respective supply mains through the primary windings K and L, and the cathode F is connected between the taps C and D. The main electromotive force for the energisation of the load circuit is taken from the taps B and E, and the secondary winding M is included in this circuit to exercise an opposing regulating effect in accordance

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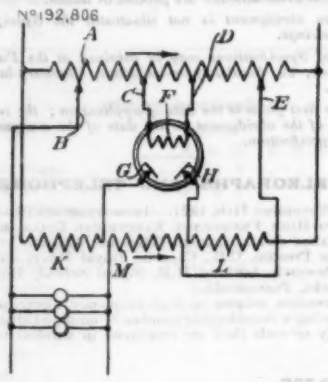

with the activity of the tube. By appropriate adjustment of the number of active turns in the different windings the tube may be caused to operate at its critical voltage.—*February 5th*, 1923.

192,744. October 13th, 1921.—IMPROVEMENTS IN ELECTRICAL CONDENSERS, George Stephen Kemp, of "Ferndale," 92, Cedar-road, Bevois Mount, Southampton.

The object of this invention is to provide an electrical condenser which can be very cheaply constructed and can be readily put together and adjusted. A number of plates A or discs with distance pieces B of rubber, such as bands or pads of rectangular cross section or rings or tubes of circular cross section are used.

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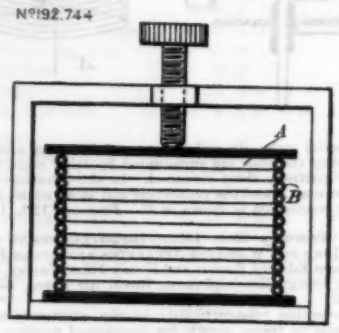

Preferably these distance pieces are attached to the plates so that a condenser may be readily made by piling the plates one upon another to the desired number. The plates may be threaded on a central stem and may be clamped together by means of a screw working on a thread cut on the stem.—*February 13th*, 1923.

LAUNCHES AND TRIAL TRIPS.

TRICENTROL; oil tank steamer; built by Sir W. G. Armstrong, Whitworth and Co., Limited, to the order of the Trinidad Central Oilfields, Limited; dimensions, 407ft. by 52ft. 4in. by 31ft. 6in.; 8250 tons deadweight. Engines, triple-expansion; constructed by the builders; trial trip, March 7th.

CITY OF SINGAPORE; steamer; built by William Gray and Co., Limited, to the order of the Ellerman-Hall Line, Limited; dimensions 451ft. by 57ft. 3in. by 32ft. 10in. Engines, triple-expansion, 24½in., 42½in., 74in. by 51in. stroke, pressure 225 lb.; constructed by the builders; trial trip, March 6th.

LOTHARINGIA; steel twin-screw vessel; built by William Hamilton and Co., Limited, to the order of the Cunard Steamship Company, Limited; dimensions 200ft. by 38ft. by 17ft.; to carry 1250 tons. Engines, twin-screw; constructed by David Rowan and Co., Limited; launch, March 8th.

MARJORIE S.; single-screw self-trimming collier; built by Swan, Hunter and Wigham Richardson, Limited, to the order of the Monkseaton Steamship Company, Limited; dimensions, 252ft. 10½in. by 37ft. 2in. by 24ft. 3in.; 2640 tons deadweight. Engines, triple-expansion, pressure 180 lb.; constructed by the builders; trial trip, March 13th.

ROBERT W. POMEROY; steamer; built by Earle's Shipbuilding and Engineering Company, Limited, to the order of the Eastern Steamship Company, Limited; dimensions, 258ft. by 44ft. by 20ft.; 2400 tons deadweight. Engines, triple-expansion surface condensing, 16in., 27in. and 44in. by 33in. stroke, pressure 180 lb.; constructed by the builders; launch, March 16th.

BELGENLAND; passenger liner; reconditioned by Harland and Wolff, Limited, to the order of the Red Star Line; dimensions, 697ft. by 78ft. by 49ft. Engines, triple screws, pressure 215 lb.; constructed by the builders; left port, March 17th.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

MR. E. J. CHRISTIAN has joined the board of Sutcliffe Bros. and Bryce, Limited, Hyde, and has been appointed general manager. He will specialise on the rope section of the business.

MESSRS. HENRY LEA AND SON, consulting engineers, of Birmingham, inform us that they have now opened an office at 43A, The Temple, Liverpool. Telegraphic address, "Aywon, Liverpool"; telephone, Central 2138.

MR. J. L. CHALONER, who practises as a consulting engineer concerning internal combustion engines and the industrial application of all classes of liquid fuel, has opened an office at Abbey House, 8, Victoria-street, Westminster, S.W. 1.

MR. C. G. H. PENNING, M. Am. Soc. M.E., asks us to state that he has opened an office at Abbey House, 8, Victoria-street, Westminster, as a consulting engineer in connection with sugar-house engineering and technology.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTION OF LOCOMOTIVE ENGINEERS.—The Engineers Club, Coventry-street, W. 1. Annual dinner. 6.30 p.m.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—Mappin Hall of the University, St. George's-square, Sheffield. Paper, "Further Notes on Britannia Metal," by Captain F. Orme 7.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. "The History and Development of the Underground Railway," by Mr. R. J. Siddall. 7.30 p.m.

INSTITUTION OF PRODUCTION ENGINEERS.—The Engineers' Club, Coventry-street, W. 1. Paper, "Modern Gauging Systems," by Mr. A. C. Wickman. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, Piccadilly, W. 1. Discourse, "Life History of an Alpha Particle from Radium," by Sir Ernest Rutherford. 9 p.m.

INSTITUTION OF ENGINEERING INSPECTION.—Royal Society of Arts, John-street, Adelphi, W.C. 2. Paper, "The Future of Steam as Applied to Motor Vehicles and Agricultural Engines," by Mr. K. W. Willans. 7.30 p.m.

INSTITUTION OF NAVAL ARCHITECTS.—Royal United Service Institution, Whitehall, W.C. 2. Annual meetings. For programme, see page 260.

SATURDAY, MARCH 24TH.

ROYAL INSTITUTION OF GREAT BRITAIN.—Albemarle-street, Piccadilly, W. 1. "Atomic Projectiles and their Properties" (VI.), by Sir Ernest Rutherford. 3 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—London graduates' visit to the works of Gwynnes, Limited, Church Wharf, Chiswick. 2.30 p.m.

TUESDAY, MARCH 27TH.

ILLUMINATING ENGINEERING SOCIETY.—Royal Society of Arts, John-street, Adelphi, W.C. 2. Paper: "Window Design and the Measurement and Predetermination of Daylight Illumination," by Messrs. P. J. Waldram and J. M. Waldram. 8 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: BIRMINGHAM CENTRE.—Chamber of Commerce, New-street, Birmingham. Paper: "Gear-boxes for Motor Cycles," by Mr. I. Cohen. 7.30 p.m.

WEDNESDAY, MARCH 28TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Birmingham Graduates' visit to the works of W. Mills, Limited, Grove-street, Smethwick. Meet outside the works, 2.45 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: NORTH OF ENGLAND CENTRE.—Assembly Room, Education Offices, Salford. Paper: "Engine Testing Appliances," by Mr. J. Okill. 7.30 p.m.

ROYAL MICROSCOPICAL SOCIETY.—20, Hanover Square, W. 1. Ordinary general meeting. 6.30 p.m.

FRIDAY, APRIL 6TH.

JUNIOR INSTITUTION OF ENGINEERS.—Cannon-street Hotel, E.C. 4. Annual dance. 6.30 p.m.

INSTITUTE OF MARINE ENGINEERS.—85-88, The Minories, Tower-hill, E. 1. Annual meeting. 6 p.m.

CONTRACTS.

MELDRUMS, Limited, has, since the commencement of the year, received orders for forced draught furnaces from seventeen separate customers, including hospitals, gas companies, a tar distillery, a colliery, a large shipbuilding company, a barracks, chemical and soap works, &c. The same firm has also received orders for steel-cased destructors from nine separate customers.

THE SPEARING BOILER COMPANY, Limited, has secured the order for an extension of the boiler plant for Newport (Mon.) Corporation Electricity Works. We understand this company has also recently secured contracts for several industrial undertakings, including boilers using waste heat gases.

THE Folkestone Corporation has just accepted the tenders of D. J. Somerville and Co., Limited, for £31,450 and the Staveley Coal and Iron Company for £13,034 10s. for the construction of a new sea outfall from the harbour along the beach close to the East Cliff and Copt Point. For the sewer 48in. diameter cast iron pipes are to be used, specially coated to withstand the action of sea water. At the lower end a chamber is to be constructed with agitating weirs to break up any solids remaining in the sewage and also to act as an air buffer against the ramming action of the incoming waves.

THE Manchester Corporation has placed a contract with J. Blakeborough and Sons, Limited, for the supply of the self-closing valves, &c., for the N. and S. Wells for the fourth pipe line from Thirlmere to Manchester. This contract completes the valve equipment required for this line, two previous contracts having already been placed with the same firm for the sluice, reflux, automatic and discharge valves and other ironwork. The total value of the contracts is roughly £60,000, and this will, we believe, be the first of the Thirlmere pipe lines to be equipped throughout with valves of one maker.

TULLY GAS PLANTS, Limited, of Newark, have received an order from Messrs. Suzuki and Co. for two 500,000 cubic feet per twenty-four hours modified "Tully" gas plants, complete with superheaters and revolving grates for the production of gas rich in hydrogen from coal. These plants will be worked in connection with the Claude process for the production of synthetic ammonia.

FOSTER BROTHERS, Limited, of Wednesbury, inform us that they have secured the contract for the high-pressure pipework for the Morwell power station of the State Electricity Commission, of Victoria, Australia.

ALLOYS RESISTANCE TO CORROSION.—A symposium and general discussion on this subject will be held at the Department of Applied Science, the University, Sheffield, on Friday, April 13th, beginning at 3 p.m. The meeting is being organised jointly by the Faraday Society, the Sheffield Section of the Institute of Metals and the Manchester Metallurgical Society. The scope of the discussion will include the new non-corrodible non-ferrous alloys, such as stainless nickel silver and the nickel-chromium alloys, as well as stainless iron and steel. A general introduction to the discussion will be given by Professor C. H. Desch, F.R.S., and numerous contributions of interest are expected. Further particulars may be obtained from Mr. G. R. Bolsover, Brown-Firth Research Laboratory, Princess-street, Sheffield, or from the secretary of the Faraday Society, 10 Essex-street, Strand, London, W.C. 2.